

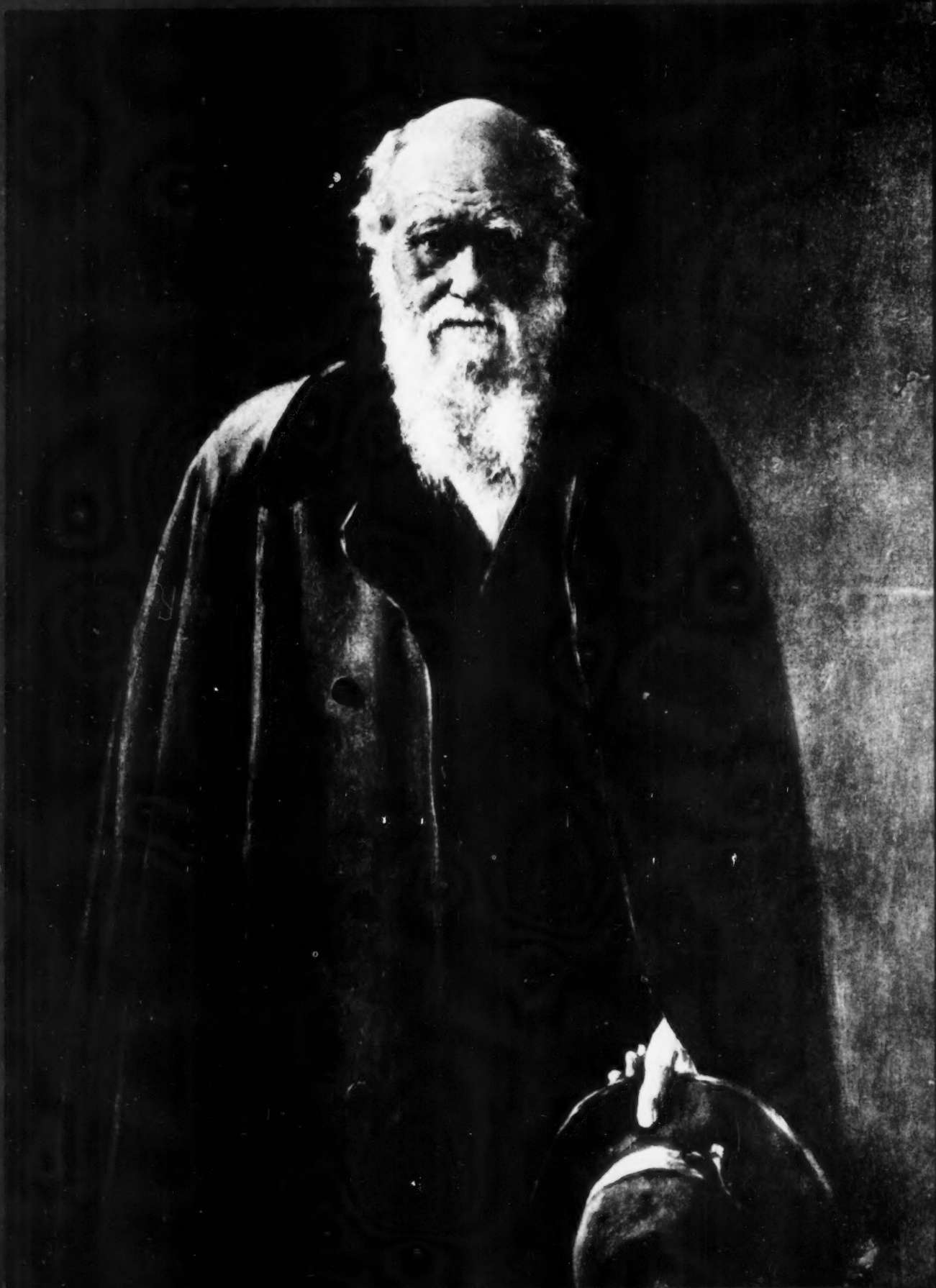
PUBLIC HEALTH REPORTS

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service



PUBLIC HEALTH REPORTS

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frontispiece

One hundred years ago, November 24, 1859, Charles Darwin published his *Origin of Species*.

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Industrial Hygiene for the Farm

by Mail Order

CLYDE M. BERRY, Ph.D

WHEN A FARMER tries to unclog the mechanical cornpicker, does he realize the danger of keeping the power on? When he enters the silo, does he know what to do to protect himself against lethal gas? Does he know how to handle safely toxic chemicals used on the farm?

Modern farming meets a growing number of hazards. How can health agencies provide the farm with the industrial hygiene services now used in other occupations?

Up to this point, the large farm population at risk has derived little benefit from the Nation's experience and skills in industrial hygiene, partly because these services have developed along custom-tailored, high-quality lines. We shrink from suggesting to the farmer a "do it yourself" program.

Nevertheless, goods and services must flow from the producer and purveyor to the consumer. A method of extending the consumption of industrial hygiene services through a mail-order technique may merit consideration. An analysis of the problems involved in such an approach indicates that it may be possible for farm application.

In an industrial setting, we in industrial hygiene have believed that only limited delegation of responsibility to nonprofessional people can

be made and a performance level be retained that meets our exacting achievement criteria. Sacred has been the conviction that there is no substitute for knowledge, skill, and experience in setting up a sampling regimen, supervising data compilation, interpreting findings, and recommending controls.

The above are valid arguments. The dollar cost of mistakes can be considerable. Injury to health, proximate and ultimate, is a potential that continually haunts us. Resurveys may need to be made. Modification of engineering controls may be required. These are expensive. The individual responsible for a mistake can lose the support of his employer and be discredited by his confreres. This is sobering to the professionally courageous and frightening to the professionally timid.

Almost all of our efforts are unique. Individual problems are exactly that—and must be so studied and controlled. With such an approach it is entirely understandable that problem solving and routine program commitments represent the major part of established programs. With limited staff it is natural to try to do the most in the least amount of time for the greatest number of people.

This situation provides a logical explanation for finding the best industrial hygiene coverage in the larger plants and in those industries with the most acute hazards. In the larger plant, operations are likely to be more continuous. Job assignments are likely to be more specialized. Presenting the findings of studies to management and getting controls initiated is

Dr. Berry, who is associate director of the Institute of Agricultural Medicine of the State University of Iowa, Iowa City, delivered this paper in substantially the same form at the 1959 meeting of the American Conference of Governmental Industrial Hygienists.

easier if management had been faced with repeated situations of a comparable nature and is "educated" to work with industrial hygiene people.

Providing industrial hygiene services for the small plant is not easy. We swim yearly through a sea of salty tears as we deplore this lack of services and fervently discuss ways and means of providing these needed services. We concede that the plants are widely scattered and travel time is considerable. The few people employed have multiple duties. Other parameters include variations in processing, transient personnel, poor plant maintenance, lack of medical supervision, inadequate housekeeping, hand-to-mouth financing, lack of mechanization, and absence of records.

Providing industrial hygiene services to the farm is a somewhat similar but even more difficult problem. The additional parameters include a most geographically diffuse population at risk; the home and the workplace are the same; management and labor are identical; the worker may be of either sex and will range widely in age, intelligence, education, normal health status, and training for a specific job.

Further complications are that the jobs may be highly intermittent; may be performed indoors or outdoors; and may be heavily influenced by the weather and climate. They are subject to considerable variation in personal hygiene and in the availability and use of personal protective equipment. There is no separate maintenance man or operator. The farmer is both.

How can an industrial hygiene service that will meet the exacting criteria we have established be provided to a one-family operation? I have grave personal misgivings that this can ever be achieved. If we have not been able to meet the needs of the small plant, how can we meet the needs of the farmer? Will there be enough money? Enough people? Can the problems which we described be circumvented?

It seems unlikely that there will be enough money and people to do the kind of job that we have held to be acceptable by our professional standards. Our choice, then, is one of necessity. We can perform individual, high-quality industrial hygiene services and be of little help to the great mass of those who need help. The

alternative is heresy: to sacrifice quality for quantity.

Let us frankly consider how such wide coverage might be provided:

Can a system be devised for enabling the farmer to identify his problem?

If there are unusual aspects to the problem, a nonstandard situation, can it still be identified? Can a farmer describe his problem in nontechnical terms?

Can the system provide for the expert but remote appraisal of nonstandard conditions? Can control suggestions be provided to the farmer in nontechnical terms—not only so he can understand them, but so that he cannot misunderstand them?

If professional heresy can be hypothetically condoned for the moment, then one can speculate further as to how these problems of the farmer can be handled from a distance. Let us suppose that it is possible to place in the hands of the farmer a device for visual association that can assist him in identifying problem areas, real and potential, known and unknown. The device would:

- Apply specifically to individual farm equipment items and operations, or either, that are used or performed by the particular farmer to whom the device is provided.
- Be sufficiently specific so that alternative control approaches are definable by the farmer as to first cost, cost of operation, service factor, and degree of probable effectiveness.
- Provide enough option in listings of size, mounting, power source, and materials of fabrication for a fairly wide range of needs, and discuss farm-use variables such as severity and duration of exposure, weather conditions, and equipment breakdown.
- List sufficient detail for satisfactory ordering, shipping, installing, and testing.
- Indicate in advance what will be involved in maintenance, storage, multiple application, power consumption, and provide a listing of depots where expendable items and repair parts may be secured.
- Emphasize comparison and choice (management prerogatives).
- Minimize coercive overtones.
- Point out profit incentives as far as possible.

• Offer reassurance that special problems can be met through mail consultation, telephone, or (under unusual circumstances) by a personal visit from a professional.

• Make provision for services such as alterations, return-for-refund, and trade-in.

• Suggest financing methods, tax credits, amortization rates, and relationships to any legal liabilities which might be involved.

• Keep performance claims conservative. This implies building in an extra margin of safety.

Our problem can be compared roughly to that of merchandising in rural areas soon after the wide expanses of America were opened up to homesteading. Railroads and stagecoaches provided the link between villages and towns. Special needs of consumers were met by making articles on the premises. Where special skills were required, as in blacksmithing and leathercraft, artisans set up shop. For regularly used items that could be mass-produced in the industrial east there was the outlet of the general store. The general store, however, was limited in the stock it could carry as to kind, size, color, material, or other features. The distance between farm and village was considerable and trips were infrequent. A government service to the individual farm or ranch provided an answer. Rural free delivery of mail made the mail-order house possible, and the combination resulted in an effective approach that may have merit in an analogous manner for the current professional dilemma which we face.

We shall need to curb our natural response—that this cannot be adapted to industrial hygiene—and approach it with an open mind. Perhaps it can be applied to industrial hygiene, if we try.

Remember, we are directing our efforts toward the mass markets, not the carriage trade. We seek to capture the industrial hygiene build-it-from-a-kit group. What changes are in order for us to provide mail-order industrial hygiene for the farm? At the risk of losing my membership in our professional societies, I would like to present the following arguments for considering such an approach.

Farmers are not being reached. Until small plant needs have been met farmers will still be

professionally neglected. They have a problem. How can we justify any delay in providing them with a needed service, however meager?

We will do more good than harm. Those instances where untoward results from faulty choice of equipment, improper maintenance, a false sense of security, and other factors will be outweighed by acceptable control procedures.

Under certain circumstances sacrificing quality for quantity can be justified. Why can't we adapt the "weighted exposure" concept to the situation? Wouldn't a little industrial hygiene for a lot of people be as justifiable as intensive service for a few?

The Catalog

Let us assume that the arguments above have been cogent and convincing. How can we make industrial hygiene for the farm by mail order work? The following methodology is offered as the first halting step in this direction.

Concentrate first on a "catalog." Prepare material that will be most amenable to a do-it-yourself approach, for hazards that have the most serious potentials, and for the largest number of farmers.

Get the catalog into the hands of the farmer. Many avenues are available: direct mail; distribution by farm children, rural organizations, or farm extension personnel; over-the-counter from farm equipment outlets or hardware stores; or on a request basis, with the demand built up by blanketing farm communication media—magazines, newspapers, radio, and television.

Concentrate heavily on timing and lucidity. The farmer has seasonal problems. Anticipate these so he can avoid emergencies and inevitable improvisations. The material should be so presented that he can see it applies to him and his operations.

Aim for standardization, "packaged" control. Inevitably this will lead back to the manufacturer, the packager, and to sales and service outlets for farm needs. It is a laudable objective in the area of farm operations. Specifications should take precedence over the traditional faith in brand name with the added information on make and model.

If all automatic silo unloaders were reinstalled at the time the silo is filled, a built-in device would be available for eliminating exposure to silo gas. The catalog might give the following instructions for ordering a spiral, wire-reinforced, flexible, cloth duct to fit the fan discharge of a silo unloader:

Diameter. Measure outside diameter between two pieces of wood held parallel to each other as shown in figure 1. This is the inside diameter of the tube. Order next larger size.

Length. Allow for settling of 15 percent of height of silo. Calculate in feet. Add distance (in feet) from center of silo to inside wall. This is the length to be ordered.

Installation. Remove blower chute; place tube over circular fan discharge opening and clamp as shown in figure 2. Attach wall hanger as shown in figure 3. Fasten to wall at window or farthest point from any nearby building.

Operation. Make visual observation from the ground that discharge end of tube is in place. Operate unloader for 15 minutes before entering silo.

NOTE: To avoid removing silage, support unloader above silage as shown in figure 4. The support should be 4-6 inches thick and approximately 24 inches in diameter.

Summary

Justification has been attempted for departing from high-quality, custom-type industrial hygiene services in order to serve a geographically diffuse population at risk. The method proposed for such a group involves many of the techniques of merchandising by mail. General suggestions for applying such a service to agricultural operations are made.

Observance Date for Child Health Day Changed

Child Health Day will be observed on the first Monday in October beginning with 1960, instead of on the traditional May 1. The change, effected through joint congressional resolution, permits the United States to link observance of that day with Universal Children's Day, which many nations observe on the October date.

Since 1956, by agreement between the United States and the United Nations, the Child Health Day proclamation has contained references to Universal Children's Day and to the work of the United Nations and the United Nations Children's Fund.

Child Health Day has been observed on May 1 every year since 1928. Since 1935, the Children's Bureau, as requested by the Association of State and Territorial Health

Officers, has sponsored appropriate Federal activities.

States and communities frequently use the day to call attention to a particular condition affecting children or to enlist community support in improving the health of children. For example, the day was once used to initiate a campaign for immunization against diphtheria and smallpox. It has also been used to emphasize the values of birth registration, community planning, prevention of home accidents, and medical and dental examinations for children entering school for the first time.

The theme of "Child Health" in 1960 is expected to reflect the significant findings of the 1960 White House Conference on Children and Youth.

Children with rheumatic fever or heart disease are given a wide range of educational services, a national survey discloses. Methods to provide these essential services in all urban areas are recommended.

Educational Services for Urban Children With Rheumatic Fever or Heart Disease

HELEN M. WALLACE, M.D.

CHILDREN with rheumatic fever or heart disease, either rheumatic or congenital in origin, were one of the first groups for whom special educational provisions were made by departments of education. These special educational provisions, over and above regular classes in regular schools, included teaching in special classes, special day schools, special residential schools, hospitals and convalescent homes, and in the child's home. Evidence of a consistent decline in the incidence and prevalence of rheumatic fever and rheumatic heart disease in children and youth is accumulating (1). Because of this obvious trend, it seems timely to look at the special provisions made for children with rheumatic fever or heart disease by public school systems in the larger cities of our country.

Method of Study

During the winter of 1958, a questionnaire was sent to the health officers and superintendents of schools of each of the 106 cities in the United States having a population of 100,000 or more according to the 1950 census. It con-

tained questions regarding the types and numbers of handicapped children cared for in the public school system; age of admission; type of school facilities; presence of established criteria for special educational placement and the agency responsible for their establishment; method of reviewing applications for special educational placement, personnel engaged in such review, and frequency of review; organization of special education within the public school system; method of financing and costs of education of handicapped children; and the provisions made for transportation and attendant service during transportation of handicapped children to and from school.

According to the 1950 census, the 106 cities had a combined total population of 44,311,716, or 29.4 percent of the total U.S. population, and a combined school enrollment of children aged 5 through 17 years of 7,192,100, or 28.4 percent of the total U.S. population. Ninety-eight of the 106 cities, or 92 percent, responded. These 98 respondent cities had a combined total population of 41,686,921, or 94 percent, and a combined school enrollment of children aged 5 through 17 years of 6,849,105, or 95 percent. All but 9 of the 98 respondent urban communities provide some special school services for children who have rheumatic fever or heart disease.

Dr. Wallace is professor of maternal and child health, School of Public Health, University of Minnesota.

Previous papers reported on the general information obtained from the questionnaires regarding all types of handicapped children and children with orthopedic, neuromuscular, or neurological conditions (2,3).

This paper summarizes the information obtained regarding children with rheumatic fever or heart disease.

Educational Placement Available

The most common types of educational placement for children with rheumatic fever or heart disease, other than regular class in a regular school, are home instruction, special day class, combination of home instruction and special day class, and special day school (table 1).

It is of some interest that 45 communities provide placement by home instruction, 29 in a special day class, 22 in classes in a hospital or convalescent home, 17 in a special day school, and 4 in a special residential school.

Table 1. Public school educational placement, by type other than regular classes in regular schools, of children with rheumatic fever or heart disease

Type of placement	Number of school systems
Home instruction only	19
Special day class only	8
Special day class and home instruction	6
Special day school only	6
Special day class, home instruction, hospital or convalescent home	5
Special day school, home instruction, hospital or convalescent home	5
Special day class, special day school, home instruction, hospital or convalescent home	3
Special day class, special residential school, home instruction	3
Home instruction, hospital or convalescent home	3
Hospital or convalescent home only	3
Special day class, hospital or convalescent home	1
Special day class, special day school	1
Special day class, special day school, hospital or convalescent home	1
Special day class, home instruction, special residential school	1
Special day school, hospital or convalescent home	1
Uncared for or not reported	32
Total	98

Table 2. Number of children with rheumatic fever or heart disease reported by school systems

Type of placement	Number of children	Number of school systems	
		Providing service	Reporting number of children
Regular class	4,065	98	14
Home instruction	755	45	41
Special day school	593	17	17
Special day class	484	29	24
Hospital or convalescent home	210	22	19
Special residential school	67	4	2

Some communities provide just one type of special placement: 19 by home instruction, 8 in a special day class, 6 in a special day school, and 3 in a hospital or convalescent home.

Officials were asked to report the number of known children with rheumatic fever or heart disease in the various types of educational placement. This question was incompletely answered on the questionnaires. There was more complete reporting of the number of children in hospital and convalescent homes, special day classes, special day schools, and receiving home instruction than of children in regular classes or in special residential schools. The largest single group of children reported was in regular classes, followed by home instruction, special day schools, and special day classes in that order. Only a few children were reported to be in special residential schools. Undoubtedly there was considerable under-reporting of children in regular classes (table 2).

Educational Placement Method

Ninety-one of the ninety-eight reporting public school systems, or 93 percent, stated that they had established criteria for the educational placement of all types of handicapped children. One each had established criteria only for cerebral palsy, for the blind, and for mental retardation. Four did not answer this question.

In almost one-half of the public school systems, responsibility for establishing criteria for

educational placement has been assumed by the local government, predominantly the local board of education. In slightly more than one-quarter, the responsibility has been assumed by the State government, predominantly the State department of education. The participation of the health department, either local or State, is very small. When the individual disciplines are listed under local government, there is medical participation in less than one-half of the methods.

In one-half of the public school systems, the board of education alone reviews applications for special educational placement. In no instance is such review done by the department of health alone. In approximately one-fifth of the school systems the review is carried on jointly by the departments of education and health. In only three school systems was the recommendation of the practicing physician acted upon without any agency review.

The number of professional personnel reviewing applications for educational placement ranged from 1 in one school system to 12 in another. The most frequent number of participants was 6 in 18 school systems. In all but two of the school systems, more than one professional person is responsible for the review of applications.

The type of professional person participat-

ing in the review of applications is of the utmost importance. The psychologist and the school administrator participate most frequently, 87 school systems reporting the use of these professions. The nurse and the teacher participate as reviewers in about one-half of the school systems, the social worker and the school counselor in about one-third. There is limited participation by such personnel as the director of special education and the vocational counselor.

In all school systems except 14, there was some type of medical participation in review of applications. It is surprising to find infrequent participation by certain medical specialists, especially the cardiologist and the pediatrician.

It is considered essential that there be a careful review of all handicapped children, not only prior to educational placement but also periodically during such placement and prior to withdrawal from such placement. The questionnaire asked for information on all three aspects. Ninety-six percent of the school systems indicated that they review all applications prior to placement, 85 percent do so periodically during placement, and 70 percent prior to withdrawal from placement. Inquiry was also made regarding the frequency of periodic review of the children during placement. At

Table 3. Frequency of review of all types of handicapped children during placement

Frequency of review	Regular class	Special day classes	Special day school	Special residential school	Home instruction	Hospital or convalescent home
Once a week				1	1	
Once a month				1	2	
Once every 6 weeks					1	
Once every 2 months		1				
Once every 3 months		1			1	1
Once every 4 months			1			
Twice a year	6	9	9		8	6
Once a year	25	33	20	7	25	10
Once every 2 years	2	7	1			1
Once every 2-3 years		2	1		1	
Once every 3 years	1	2	2			
As recommended by family physician					3	6
Left to staff of institution						2
No definite plan	18	18	11	9	14	15
Frequency not stated	1	2			3	
Prior to return to school					1	
Not done at all					2	
No information or not applicable	45	23	53	80	36	57
Total	98	98	98	98	98	98

least once a year, 45 percent of the school systems review children in special day classes, 39 percent review children on home instruction, 32 percent review children in regular class, 31 percent review children in special day school, 17 percent review children in special hospitals and convalescent homes, and 9 percent review children in special residential schools. The stated range of frequency of review varied from once a week (in one special residential school and on home instruction) to a complete lack of review for children on home instruction in two school systems (table 3).

Because it is recognized that "paper review" of children may not provide as complete a picture of the child, his progress, and his needs as a personal visit with the child and his family, the questionnaire asked if a team of personnel, either from the board of education or the department of health, sees and evaluates all handicapped children personally. Thirty-eight percent of the communities provide such a team, 35 percent do not, and 27 percent did not answer this question. The number of persons employed on a team basis for evaluation of the rheumatic fever or cardiac group vary from one person in about 10 percent of the communities to six persons in two communities. The majority of the communities provide a team of from one to three people as shown below.

<i>Number of personnel</i>	<i>Number of school systems</i>
One	9
Two	12
Three	8
Four	0
Five	1
Six	2
Team	1
Clinic	4

A psychologist and a physician (whose type was not stated) were most frequently on a team. Other personnel used with some degree of frequency were the teacher and the nurse. Community facilities were used rarely, and personnel such as social workers, school counselors, school physicians, and certain medical specialists (pediatrician and cardiologist) were used relatively infrequently. Another surprising finding was that a crippled children's clinic was reported as being used in only

two instances. In three communities, there was team evaluation of children with rheumatic fever or heart disease without any medical participation on the team. The type of personnel engaged in team review and the number of school systems reporting are shown below. Replies were received from 37 cities, 28 indicating that more than one person is used for evaluation.

<i>Type of personnel</i>	<i>Number of school systems</i>
Psychologist	11
Teacher	7
Administrator	5
Nurse	5
Therapist (type unspecified)	2
Director of special education	2
Counselor	2
Physical therapist	1
Social worker	1
Occupational therapist	1
Speech therapist	1
Medical :	
Type not specified	15
Cardiologist	4
School physician	3
Pediatrician	2
Medical director	1
Health department physician	1
Community facility used :	
Crippled children's clinic	2
Clinic physician	1
Consulting clinic	1
Diagnostic team	1

In approximately two-thirds of the public school systems, there is a department of special education with its own director. In approximately one-fifth of the public school systems, special education is a part of another department of the school system.

Of the 98 communities reporting, 50, or 51.1 percent, provide children with rheumatic fever or heart disease transportation to and from school, and 48, or 48.9 percent, do not. Sixteen communities provide attendant service during transportation, or 16.3 percent of the school systems reporting and 32 percent of the school systems providing transportation. In other words, 83.7 percent of the school systems reporting do not provide attendant service during transportation for this group of children, and 68.0 percent of school systems providing transpor-

tation for these children do not also provide attendant service.

Discussion

The foregoing data may be summarized as follows:

- All but 9 percent of the urban public school systems provide some school services for children who have rheumatic fever or heart disease.
- Educational placement of children with rheumatic fever or heart disease, other than regular class in regular school, is most frequently home instruction or special day class, or a combination of these.
- About one-half of the school systems provide placement by home instruction, one-quarter in a special day class, one-fifth in a hospital or convalescent home.
- Thirty-six communities, or 36 percent, provide just one type of educational placement.
- Most of the children are in regular class, with smaller numbers in home instruction, special day school, or special day class.
- In one-half of the communities, criteria for special educational placement have been established by the local board of education, with little participation of the local or State health department.
- In one-half of the communities, all applications for educational placement are reviewed separately by the board of education, and in one-fifth, this review is maintained jointly by the board of education and the department of health.
- In most school systems, applications for special educational placement are reviewed by more than one person, the most frequent disciplines being psychology and school administration. Although there is usually some medical participation, it is rarely a pediatrician or cardiologist.
- Most children are reviewed prior to placement, 85 percent are reviewed periodically during placement (although the frequency varies considerably), and 70 percent are reviewed prior to withdrawal from placement.
- About one-third of the communities provide for team evaluation of children with rheumatic fever or heart disease. The team is usually composed of one to three people, most fre-

quently a psychologist and a physician; infrequently, a cardiologist.

• One-half of the communities transport this group of children to school and one-third of the communities which supply transportation also give attendant service.

Thus the quantitative information indicates that there is less variety of special educational services for children with rheumatic fever or heart disease in most urban communities than for children who are orthopedically handicapped (3), and therefore less flexibility for them. But what of the qualitative information?

A study of 74 eighth grade children in special cardiac classes in one community in 1951 (45) indicated that 3 (4 percent) had no heart disease; 21 (28 percent) had possible and potential heart disease (patients in whom the symptoms or signs, though suggestive of heart disease, did not justify a definite diagnosis and from whom a history of an etiological factor which might cause heart disease was obtained); and 50 children (68 percent) had organic heart disease. Of the 50 children with organic heart disease, 37 had rheumatic and 13 had congenital heart disease. Two required no limitation of physical activity, and 39 were permitted to engage in all physical activities except violent competitive sports. Thus, 41 children with organic heart disease, 3 non-cardiacs, and 21 with possible and potential heart disease (a total of 87.9 percent) probably did not require placement in special classes on the basis of medical criteria. Of the remaining nine children with organic heart disease, significant restriction was indicated. Included in the nine were two children with tetralogy of Fallot, one with interventricular septal defect, three with rheumatic heart disease with marked cardiac enlargement, and three with organic disease who had active rheumatic fever less than 1 year prior to the examination.

A subsequent smaller study conducted in 1952 by the New York City Department of Health on all 19 children in two cardiac classes in an elementary school found 6 children (32 percent) were over-restricted, 1 was restricted insufficiently, and 12 children (63 percent) were appropriately placed. Of the 19 children, 13 had

rheumatic heart disease, 5 had congenital heart disease, and 1 had no heart disease.

An evaluation of 10 homebound cardiac children by a team composed of a pediatric cardiologist, a public health nurse, and a medical social worker found 6 children with heart disease (4 severe, 2 mild), 3 children with potential heart disease (history of rheumatic fever but no heart disease), and 1 child, a non-cardiac (6). Of the 10 children, 3 had rheumatic fever, 1 had congenital heart disease, 5 had rheumatic heart disease, and 1 was non-cardiac. Eight of the ten families visited needed public health nursing service, interpretation of illness, anticipation of developmental and emotional problems, and specific dietary and postural advice. Seven of the ten families needed casework service because of the length of time the children were homebound rather than the fact of the illness itself. Most families expressed an additional need for planned recreational programs for the cardiac homebound who is not confined to bed. There was also a need for vocational assistance among the adolescent children.

There is evidence to indicate that in some instances there may be erroneous information regarding the child's diagnosis; there may be inappropriate placement of the child, mostly in the direction of overplacement; and there may be over-restriction of a child's activities.

Recommendations

On the basis of these findings, certain specific recommendations may be made:

1. That each urban community have a range of special educational services for school children with rheumatic fever or heart disease, including special day class, home instruction, and teaching in a hospital or convalescent home.
2. That the local board of education and department of health jointly, with the assistance of professional experts from the various disciplines concerned (pediatrics, cardiology, education, public health nursing, social work, and vocational counseling), establish criteria for the special educational placement of these children.
3. That all applications for the placement of these children be reviewed by a team composed

of the various disciplines listed in the second recommendation prior to placement, periodically during placement (preferably every 3 months), and prior to withdrawal from special placement. Furthermore, it is recommended that children who are in regular classes and have had rheumatic fever or have heart disease be followed carefully. Whenever there is any question, the team should see the child and his family personally rather than rely upon "paper" information only.

4. Because of the need, children with rheumatic fever or heart disease who receive home instruction or are in a special day class or school should be considered a high priority group for public health nursing service.

5. Because of the difficulties of diagnosis, each large urban area should have at least one diagnostic and consultation service for children with rheumatic fever or heart disease to which practicing physicians, school health services, and well child conferences may refer these children for a diagnostic workup. This service might be provided by the local health department, the official crippled children's agency, a local hospital, or the school health service itself.

6. Because of the well-known value of prophylaxis against recurrences of rheumatic fever, it is recommended that school health service personnel periodically (preferably every 3 months) review the current status of each child with a verified history of rheumatic fever. When such a child is not on prophylaxis, school health service personnel should discuss this procedure both with the child's physician and the family.

7. Because of the rapid advances in diagnostic and surgical techniques any child who gives evidence of congenital heart disease and who has not been given an adequate diagnostic workup should be referred for this service.

8. Placement of children in other than regular classes in regular schools should be made only after it is clear that the child cannot possibly fit into this normal setting.

9. Recorded data with adequate information on the continuity of care from the treatment agent or agency is essential, if there is to be a clear picture of the child's course.

10. Wherever possible, the educational setting should be modified to fit the child rather than attempting to place the child in a setting which may be inappropriate.

Summary

Data on children with rheumatic fever or heart disease are extracted from findings of a national survey conducted in 1958 to ascertain the status of school services for all handicapped children in cities having a population of 100,000 or more. Wide variation exists in the range of services, policies, and personnel concerned. Recommendations are made to assure these children the benefit of essential services in all urban areas.

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The Yearbook of Agriculture, 1959

In the publication, "Food—Yearbook of Agriculture 1959," the U.S. Department of Agriculture presents 66 articles which represent a comprehensive range of approaches to the subject of food. Contributed by authorities in their respective fields, the articles are grouped under headings such as "The Nutrients," "Health," "Quality," "Preparation," "Costs," and "Trends."

For men, the editor, Alfred Stefferud, recommends articles such as "Nutritional Needs After 25," "What Your Food Money Buys," and "Feeding 6,280 Million." Titles of special interest to parents and teachers include "The Story of Nutrition," "A Table of Food Values," and "Habits—and More." Farmers are directed to "Quality in Animal Products," "Marketing, Quality, and Cost," and "Conserving Nutritive Values."

Also featured are "Adolescents and Young Adults," "Youth Learns About Food," and "Trends in Heights and Weights."

There are 736 pages, liberally illustrated with drawings, charts, and graphs, in the yearbook, the latest in the series of annual volumes that have been printed for 110 years.



Nutrition studies with human beings supplement research with laboratory animals. This group of young women and other such groups serve as volunteer squads to help nutrition researchers find out more about the relation of food to health. Under careful supervision the diet squad follows a rigidly controlled diet for many weeks. A variety of detailed analyses show how the body uses certain nutrients, whether the diet supplies enough of each, and how the nutrients depend upon each other in metabolism. Such studies of men and women of different ages are being carried out in laboratories throughout the country.



American Nurse in Moscow

"Are American policemen trained to deliver babies on the streets because American mothers can't afford to pay for the doctor?"

"Isn't it true that in America if a person has an acute attack of appendicitis and doesn't have the money on him to pay beforehand for the operation, he just has to die?"

"Why is it that in America if a worker has an industrial accident he is thrown out of the plant for good?"

Mrs. Rose G. Ernsberger, a Russian-speaking nurse officer of the Public Health Service, spent her summer answering these and similar questions on American public health practices at the American National Exhibition in Moscow. The exhibition enjoyed a daily attendance of some 60,000 Russians, of whom hundreds flocked to the public health exhibit to see and hear about medicine in the United States.

From 11 a.m. to 9:30 p.m. 7 days a week, Mrs. Ernsberger was subjected to a bewildering array of questions about American treatment of cancer, heart disease, hypertension, bronchial asthma, tuberculosis, stomach ulcers, and almost every other illness.

Each day, as soon as she stepped up to her lecture stand under the exhibition's geodesic dome and plugged in her microphone, a crowd gathered. "At first they were rather shy and stayed back from the platform as if they didn't know what to say. Then someone would gather his courage, rush up to the stand, and demand to know 'how do you treat such-and-such?' This signal would break the ice, and others would crowd around," according to the nurse.

"They wanted to know if we permit abortions, how we cure sterility, and what sort of aid we give to expectant mothers. The last question is especially important to Soviet workers, because mothers there have to work in

order to bring the family income up to some reasonable level. It was quite a revelation to them to hear from me that, although we do have annual sick leave, pregnancy allowances, and other benefits, we don't have any well-defined national system for pregnancy care because we Americans generally feel that mothers should stay home and take care of their children.

"Another question concerned day nurseries. Working mothers in the Soviet Union leave their children in such nurseries, which are common throughout the country. They wanted to know why we do not have many such nurseries. The answer was that our mothers take care of their own children. They seemed to understand that."

The Russians have been taught to believe that there is no free medical care in the United States and that good medical care in general is too expensive for the average working family to afford. Mrs. Ernsberger told them: "There are 26 million families in the United States with hospitalization insurance. Free medical care is given by Government hospitals, private clinics, and a variety of other public and private institutions. The decision whether a patient pays or not is made by public health nurses and social workers. Anybody in the United States can get medical care, whether he can pay for it or not."

Most of the Russian visitors to the exhibition believed the answers, but almost every group around her contained one or two hecklers. If they loudly expressed doubt, Mrs. Ernsberger would say, "I've been a nurse in America for 30 years and a public health nurse for 18. If you don't believe me, this doesn't hurt us Americans at all, because we still get the same splendid services. I know, because I live there."

National Hospital Insurance in Canada

FRANCIS d'A. COLLINGS, M.A.

JULY 1, 1959, marked the first anniversary of national hospital insurance in Canada. It is too early yet to evaluate the new Canadian program in terms of experience, since only half of the 10 Provinces have participated for the full year, and data on costs, utilization, and other matters of interest are not yet available. It is an appropriate time, however, to survey some structural details of the new program. With respect to the financing of hospital care, as in many other areas, Canada has evolved what is essentially a middle way between American and British practice. The hospital insurance system now emerging in Canada is sufficiently different from our own—and in a general social, economic, and political setting sufficiently similar—to merit close interest in the United States.

The background of the Canadian hospital insurance program and the history of events that led up to it have been adequately described elsewhere (1,2). This report will sketch briefly the outlines of the national program, and then describe in greater detail some aspects which may be of particular interest to those concerned with health and medical care planning in this country. The report is based partly on published material, partly on conversations with officials of the Department of National Health and Welfare in Ottawa and other persons in the Canadian health field.

The Federal Act

The Hospital Insurance and Diagnostic Services Act, authorizing "contributions by Canada in respect of programmes administered by the Provinces providing hospital insurance and laboratory and other services in aid of

diagnosis" (3), was enacted by unanimous vote of the Canadian Parliament more than 2 years ago. Its effectuation was delayed by a requirement that a majority of the 10 Provinces, having among them at least 50 percent of Canada's total population, be ready to participate. This requirement was eventually deleted, and the program commenced on July 1, 1958. The deletion was made in order to get the program started without waiting for Ontario. This province, with almost one-third of Canada's population, was by then fully committed, although its plan was not due to start until January 1959.

The act provides for a Federal contribution of approximately 50 percent of the costs of Provincial hospital insurance plans. The plans must provide certain benefits and meet certain conditions laid down in the act, but otherwise are entirely Provincial responsibilities. Details of participating plans are drawn up in written contractual agreements between Federal and Provincial governments, an arrangement constitutionally in accord with the British North American Act of 1867 (Canada's written constitution), which makes health and welfare specifically a Provincial responsibility.

Inpatient hospital benefits that must be provided by participating Provincial plans include:

- Ward-level accommodation and meals for as long as the physician considers them medically necessary.
- Necessary nursing services.

At the time this paper was written, Mr. Collings was an economist in the Division of Public Health Methods, Public Health Service. He is presently with the International Monetary Fund.

- Diagnostic procedures together with necessary interpretations, including laboratory and radiological tests (but excluding clinical procedures related to diagnosis, which are considered medical rather than hospital services).

- Operating room, case room, anesthetic facilities, and such items as routine surgical supplies.

- Drugs, biologicals, and related preparations used in the hospital, as prescribed by the physician.

- Radiotherapy and physiotherapy where available.

- Services of salaried hospital personnel, excluding physicians giving medical and surgical care to individual patients, but including services provided by interns, residents, medical administrators, physiotherapists, radiotherapy technicians, occupational therapists, and social workers employed by the hospital.

Optional services which the Province may include as part of its hospital plan are:

- Rehabilitation and cancer programs.

- All or some of the above inpatient services on an outpatient basis.

An important condition for Provincial participation is that all these benefits, required or optional, must be available to all residents of the Province upon "uniform terms and conditions" (3), without restrictions, for example, as to age or income. This does not necessarily mean that coverage must be compulsory for all residents, although in fact most Provinces have chosen to make it so. Residency in the Province is defined to apply to everyone who makes a home there, including U.S. citizens, "new Canadians" (new immigrants), and other foreign citizens. Tourists and transients are excluded.

It must be stressed that these benefits cover only basic hospital care, and do not cover medical and surgical services provided in hospitals by physicians (including anesthetists), except insofar as provided by salaried hospital personnel, as mentioned earlier. If the patient wants accommodation above that provided at the basic level, for example, a private room, he must pay the extra cost. Mental and tuberculosis hospitals do not come under the program, nor do nursing homes, although patients in these institutions are eligible for transfer

to general hospitals for insured hospital care if deemed medically necessary.

The Federal Contribution

The act, as well as specifying minimum requirements of participating Provincial plans, sets out the formula which determines the Federal share of the cost of the Provincial plan. This formula is related to hospital costs in the Provinces rather than to fiscal capacity or need.

The Federal contribution to the cost of each Provincial plan is 25 percent of the per capita cost of inpatient services in the Province plus 25 percent of the per capita cost of inpatient services in Canada as a whole, multiplied in each case by the average number of insured persons. The Federal contribution to all Provincial plans is thus approximately 50 percent of cost, although for individual Provinces it will vary from about 45 percent in high-cost Provinces such as Ontario to about 72 percent in low-cost Provinces such as Newfoundland. The costs of outpatient services, where provided, are shared in the same proportion as those of inpatient services. Monthly advances are made to the Provinces pending final calculation of these figures at the year's end.

To give an example of how this grant formula works, the average per capita cost of inpatient services for Newfoundland in 1959 is currently estimated by the Department of National Health and Welfare at \$17.17, and for Canada at \$24.84. (Details of how these figures are computed will be examined later.) Newfoundland then receives 25 percent of its per capita cost, or \$4.29, plus 25 percent of Canadian per capita cost, or \$6.21, making a Federal contribution to Newfoundland for inpatient services of \$10.50 per person. Ontario, whose per capita cost is estimated at \$26.60, would receive \$6.65 plus \$6.21, totaling \$12.86—a larger absolute amount per capita, but a smaller proportion of total cost per capita.

Since the Provinces with the lowest per capita hospital costs are also the poorest, this formula does tend in fact to give greatest assistance to those with the lowest fiscal capacity. The formula is designed, however, to exert an equalizing influence on hospital standards

Note on Federal Aid to Health Programs in Canada

While Canada, particularly in the postwar years, has placed growing emphasis on unconditional fiscal aid to the Provincial governments, the conditional grant programs have not been neglected. They have covered a wide range with heavy emphasis on health and welfare.

The relative importance of conditional and unconditional grants has been sharply altered, however, with the coming into effect of hospital insurance in July 1958. With only six Provinces participating in the first year, the Federal cost in fiscal year 1959 should not exceed \$70 million. With all Provinces in, the cost will rise to about \$200 million. Total conditional grant payments have not much exceeded \$100 million in any year since the old age security payments became a sole Dominion responsibility in 1952.

In all its conditional grant programs, Canada has resisted the arguments in favor of fiscal need differentials in the scale of payments to the various Provinces. This was not because the Provinces do not differ widely in their relative wealth. They do, indeed. Personal income per person varies from \$768 in Prince Edward Island to \$1,676 in Ontario, with a national average of \$1,395. Rather, it was because in recent years these programs had developed alongside the general unconditional fiscal aid arrangements, which, it was felt, made a fiscal aid factor in the conditional grant programs superfluous.

This unconditional assistance has increased substantially from year to year, but nevertheless it could be said with good reason that these special programs laid a heavier proportionate burden on the revenues of the poorer Provinces, sometimes with budgetary side effects in the relative emphasis accorded different services.

The problem was further complicated with the hospital insurance program by its very size, which

made the relationship to the scale of unconditional aid rather tenuous, and by the fact that standards of facilities and services differed widely from Province to Province. These widely different standards were not considered in keeping with a truly national scheme, and some additional incentive to improvement was required. Further, it was realized the scheme would never get off the ground in the poorer areas without a special stimulus. The situation was modified substantially by the expectation, based on experience, that costs would tend to even out as facilities were developed. Any large cost differential was considered likely to be of fairly limited duration.

The method devised to meet the situation was unique, at least in Canada's experience. The Federal share was to be 50 percent of the accepted cost. To meet the special regional problems it was decided to pay each Province 25 percent of the average per capita cost of hospital services in Canada as a whole plus 25 percent of the average per capita cost in each Province, multiplied by that portion of the Provincial population eligible under the particular scheme.

Thus, although the Federal cost is 50 percent for Canada as a whole, it is more than 70 percent in the poorest Province with lowest costs and between 45 and 50 percent in wealthier areas with well-developed services.

The contribution of this distribution to the fiscal well-being of the Provinces is secondary. The real test will be whether it is successful in raising standards of care in the less-favored Provinces of the federation, as would seem proper in a scheme that it essentially national.—R. M. BURNS, *Director, Federal-Provincial Relations Division, Department of Finance, Ottawa.*

rather than to equalize hospital costs as such. A poor Province such as Newfoundland, which now has nearly three-quarters of the cost of its plan paid by the Federal Treasury in Ottawa, will be enabled to raise salaries and improve standards in its hospitals. As it does so, the per capita cost of hospital service under the Provincial plan will rise and the proportionate

contribution of the Federal Government will fall.

There are no limits on the size of the Federal contribution. This exerts economic pressure upon the Provinces to increase the scope of their hospital plans by including services optional under the Federal act, such as outpatient service and rehabilitation programs.

As far as the Provincial authority is concerned, these services may be added to the plan at half cost, since the other half is paid by Ottawa. It is hoped that, as facilities become available, this pressure will induce all Provinces to provide the maximum range of services allowed under the act.

The maximum cost of the program to the Federal Government, with all Provinces participating, has been estimated at \$215 million per year at current prices (4). Provincial governments collectively would provide an equal amount, making the maximum total cost of the program \$430 million, or about 1.3 percent of the Canadian gross national product. An equivalent figure with regard to the U.S. economy at the present time would be in the region of \$6 billion. Very little of the program cost represents new cost to the economy: it represents rather a consolidation of the expenditures for hospital service formerly made by individuals (either directly or indirectly through insurance), charitable groups, and all levels of government under a number of smaller programs.

The Federal Government finances its share from consolidated revenue; there is no special Federal tax for the hospital insurance program.

The Provincial Agreements

Thus far, only Quebec has failed to take advantage of the new program. Two Provinces, British Columbia and Saskatchewan, have had compulsory hospital insurance plans for some years, and these came into the national program substantially unchanged. Manitoba, Alberta, and Newfoundland commenced their plans on the effective date of the act. The last two of these previously had partial hospital plans—a municipal hospital program in Alberta and the Cottage Hospital program in Newfoundland—which have been incorporated in the new arrangements. Ontario and Nova Scotia started their plans on January 1, 1959, and New Brunswick on July 1, 1959. The remaining Province, Prince Edward Island, is expected to have an operative plan by the end of the year. Plans for the two Federally governed Territories in the north are fairly well advanced, and it is hoped to bring them in early in 1960.

The blueprint for each participating Provincial plan is contained, as mentioned earlier, in a formal agreement signed by both Federal and Provincial governments. This agreement is paralleled by enabling legislation in the Provincial legislatures and forms in effect a contract between the two levels of government. A list of the points that must be covered in each Provincial agreement is specified in the Federal act.

First, a schedule of hospitals which are to provide insured services is specified. These include general, chronic, and convalescent hospitals and such facilities as laboratories and radiological centers, but not mental and tuberculosis hospitals or nursing homes as such. It was felt that individual listing was simpler and more flexible than attempting to define broadly the type of "hospital and other facility" to be included. As well as the scheduled hospitals, which form the majority, there are also listed a small number of contract hospitals (usually company hospitals in outlying areas) which are reimbursed for insured services at an agreed flat rate per capita rather than according to actual expenses. Psychiatric wards in general hospitals can be included, although separate facilities for mental care can not.

The Provincial agreement also lists other acts of Provincial and Federal legislatures which already entitle certain groups of persons to hospital benefits. These include legislation regarding workmen's compensation and benefits for veterans, servicemen, and Royal Canadian Mounted Police. Benefits provided under these special acts are not paid for again by the Provincial hospital insurance plan, although of course the necessary services may be given in Provincial hospitals.

The "scheme for administration" is an integral part of the written Provincial agreement. This includes details of the appointment and duties and responsibilities of the Provincial hospital authority; arrangements for licensing and inspecting hospitals; method of reimbursing hospitals for insured services; and plans for future development of health services in the Province.

Finally, the agreement specifies the range of drugs and biologicals to be supplied in hospitals as part of insured hospital service.

The Federal act and the written agreements with the Provincial governments setting up the framework of the national hospital insurance program in Canada allow considerable individuality in Provincial plans.

Differences in Provincial Plans

The method of financing the Provincial share of the cost of the plan is one point of difference. Four of the eight Provinces with plans now in operation (Ontario, Manitoba, Saskatchewan, and New Brunswick) have chosen to levy premiums on the insured population. Annual rates are \$25.20 for single persons and \$50.40 for families in Ontario, \$24.60 and \$49.20 in Manitoba, \$17.50 and \$35 in Saskatchewan, and \$24.60 and \$49.20 in New Brunswick (5). The other Provinces finance their share from general revenue or special sales taxes.

On the issue of compulsory versus voluntary coverage, clearly only "premium Provinces" can allow residents a choice of whether to contribute or not. The Ontario plan makes coverage compulsory for employees working in establishments of more than 15 persons, but for others it is optional, with voluntary registration and payment of premium. This arrangement was adopted not out of deference to the principle of voluntarism, but rather because of the difficulty in collecting compulsory contributions among small groups and the self-employed. Alternatives to the Provincial plan in the form of nonprofit or commercial insurance for basic hospitalization are now forbidden, so the effective choice for Ontarians is Provincial hospital insurance or no hospital insurance. Ninety-three percent of the population of Ontario is now in fact covered by the Provincial plan. New Brunswick and Prince Edward Island have adopted similar arrangements, but in all other participating Provinces coverage is in effect compulsory for all residents.

Deterrent charges, or "hesitation fees," have been adopted by two Provinces of the eight. British Columbia, whose plan dates from 1949, continues to charge \$1 per day for hospitalization. Alberta levies a variable charge of from \$1.50 to \$2.00 per day depending upon the size of hospital, and a flat \$1 per day (up to a maximum of \$30) for newborns. These charges

are expected to meet only a small part of total cost—about 6 percent in British Columbia and 12 percent in Alberta (4)—and their main intent is to control utilization.

Each Province must provide at least the inpatient services specified in the act. Most of them, for the present, limit services insured under the Provincial plan to this level, but there is nothing to prevent a Province from providing a wider range of services if it wants to pay for them itself. Thus, Ontario and in effect Saskatchewan as well have chosen to include care in mental and tuberculosis hospitals as part of insured benefits, the additional costs being met entirely from Provincial revenues. Whether as a part of insured hospital benefits or under other public programs, the Provinces of Canada, like the States in the United States, subsidize care in tuberculosis and mental hospitals.

Insured outpatient services, optional to the Provinces, vary across the country. Newfoundland, for example, provides outpatient laboratory and radiological services, encephalograms, cardiograms, and basal metabolism estimates, all together with necessary interpretations, radiotherapy and physiotherapy treatment for ambulatory patients, and other outpatient care provided by salaried hospital staff. At the opposite end of the scale, Alberta provides no outpatient services at all. All other participating Provinces include at least emergency outpatient service within 24 hours of an accident (48 hours in Nova Scotia). The small range of outpatient benefits in several Provinces is regarded as temporary, to be liberalized as the plan gets underway. Manitoba has already (in February 1959) extended its coverage of outpatient benefits in the interest of reducing pressure on inpatient facilities, and others may follow suit shortly.

Limitations on drugs that may be prescribed as part of insured hospital service also vary. Most Provinces have left the matter to be decided according to accepted medical practice, with some provision for medical review. Saskatchewan and British Columbia, possibly through longer experience, have listed certain exclusions. Saskatchewan, for example, excludes amino acids, injected antibiotics other than penicillin, and streptomycin; and British

Columbia, cortisone and ACTH. Saskatchewan maintains an approved list of new drugs. All Provinces exclude preparations sold under the Proprietary or Patent Medicines Act. Excluded drugs may, of course, be used in hospitals, but the patient must pay for them.

The Provinces are required to name an authority responsible for the operation of the Provincial plan. In three of them, Saskatchewan, Alberta, and Newfoundland, a division of the Provincial health department has been given administrative responsibility. These three all had hospital plans of greater or lesser scope under their departments of health before the new program commenced. British Columbia, which also had an earlier plan, has retained its separate Hospital Insurance Service which reports through a commissioner directly to the Provincial minister of health, and Manitoba has adopted a similar arrangement. Ontario, Nova Scotia, and New Brunswick have set up independent hospital commissions with membership representative of medical, hospital, labor, and other fields. Prince Edward Island is expected to do likewise.

Hospital Costs

Individual hospitals are reimbursed in full by their Provincial hospital authorities for the operating costs incurred in providing insured services under the Provincial plan. The detailed procedure for making these payments varies among the Provinces. Most Provinces make monthly or semimonthly advances to the hospitals according to a per diem rate established from the annual budget for each hospital, with necessary adjustments being made at the year's end when the final accounting of actual costs is completed. Ontario tried a dry run in 1958, before payments were actually commenced, to familiarize all concerned with this procedure. Some Provinces differentiate fixed and variable hospital costs, paying the hospital a flat monthly or semimonthly sum plus an amount varying with the hospital's actual patient load.

All scheduled hospitals in each participating Province are required to render uniform accounts of their costs, which are ultimately audited at both Provincial and Federal levels. Items that seem excessive or unnecessary in re-

lation to costs in other hospitals may be disallowed, although close cooperation between the various accounting units augurs a minimum amount of friction in this respect. A useful byproduct of this system will be the further standardization of hospital accounting procedures across Canada—already made reasonably uniform by use of the Canadian Hospital Accounting Manual—which will eventually yield much valuable comparative information on hospital costs.

The calculation of what the allowable cost actually is in each hospital is naturally a complicated accounting process which cannot be fully described here. Some general features will be described, however, because they are crucial to the financial relationship between hospitals, Provincial hospital authorities, and the Federal Government.

Total hospital costs include all normal operating expenses of the hospital such as wages and salaries, surgical supplies, food, linen, purchases of furniture and technical equipment (other than ambulances), and administration. Volunteer labor, paid nominal or no wages, may be counted as if it were paid in full at going rates, an important provision particularly for hospitals run by religious orders.

The allowable hospital cost, however, does not include interest and carrying charges on the hospital's outstanding debt or depreciation on hospital plant, buildings, and land. This important exclusion in effect restricts the program to current hospital expenses, leaving capital costs to be financed by the hospital itself or the Provincial government as before. Hospital deficits, therefore, are not necessarily wiped out, and the program offers no direct assistance with the costs of construction or hospital expansion.

This exclusion of capital costs is the principal point of controversy in Canada over the act. Why was it decided to do this? Primarily, because no equitable formula could be devised that would include capital costs without unduly favoring some hospitals and Provinces at the expense of others. The amount of outstanding hospital debt and the degree of assistance given hospitals by their Provincial governments differ widely across Canada. Some Provinces, British Columbia, for exam-

ple, have Provincial arrangements which finance a large part of the hospital's capital cost, while others leave this to local communities, voluntary giving, or market fund raising. With such wide differences in capital costs, it was felt that a program designed primarily to insure hospital services should cover the operating costs only.

There were other subsidiary reasons for excluding capital costs. Sharing capital costs might involve the Federal Government in the difficult and controversial question of who owns the hospitals. It was desired to avoid any charge of nationalizing the hospital system. Also, it was felt that the continued need for local communities and their local and Provincial governments to finance the bulk of their capital costs themselves would insure maintenance of local interest and participation in hospital affairs, and would restrain the urge to build unnecessary facilities in small communities for reasons of local prestige rather than medical need.

Actually, hospitals are not left entirely unassisted with their capital costs. In hospitals employing volunteer labor, there will be considerable surplus on account of salaries which may be applied to meeting interest payments. Federal and Provincial aid with hospital financing under programs unconnected with the hospital insurance program continues. There is also in the act one provision designed to allow a certain amount of "free money" to hospitals to use as they wish. In general, the costs of services not insured by the Provincial plan are not reimbursed by the Provincial authority, since the patient is charged for them directly, but, of the amounts receivable (less bad debts) from patients for accommodation above ward level (representing the extra cost to the hospital of providing this preferred service), only one half must be deducted from total cost. This means, in effect, that the patient is charged for the additional cost of a private room, and then the hospital receives half this amount again from the Provincial authority. In hospitals which provide a considerable amount of non-ward care, this provision will allow a substantial inflow of free funds which may be used for capital purposes.

There are also certain other minor hospital

costs which must be deducted before the hospital's bill is sent to the Provincial authority. In general, all sales and recoveries fall into this category; this might include such items as private laundry, sale of drugs not provided under the Provincial plan, and sale of cigarettes and candy. The hospital cannot charge the Province for functions which are already paid for from other sources, for example, training of personnel to the extent that it is financed by health grants and other governmental programs. The costs of providing noninsured services, such as ambulance service, must likewise be excluded from the hospital's accounting of allowable cost.

Sharable Cost

The Province's hospital bill consists of the consolidated amounts paid to all scheduled hospitals in the Province, as described above, together with amounts paid to the contract hospitals for insured services they provide. Administrative costs of the Province's program, as distinct from administrative costs of individual hospitals, are not included, although some help may be made available for technical consultant and research services under the separate health grants program.

Several more adjustments have to be made, however, before the Province's "sharable cost," the cost which the Federal Government is to share in, is finally determined.

There will be in each Province some hospitalization provided to residents of other Provinces who are insured under the plan of their Provincial government. The costs of these services are reclaimed from the home Province of the persons concerned, and, therefore, must be deducted from the total Provincial cost. A similar deduction must be made for persons treated in Provincial hospitals whose care is already paid for under existing Federal and Provincial acts (for example, veterans and those receiving workmen's compensation), and for those whose care is claimable under the terms of any private liability insurance contract. The purpose of these provisions is to avoid duplication of payment for the same service. Added to the Province's hospital bill, however, are the corresponding amounts paid to other Provinces for care provided to insured persons and, incidentally,

to hospitals in the United States which treat visiting Canadians.

In the Provinces which charge deterrent fees for hospitalization, the amounts thus collected must be deducted from the total sharable cost, since they represent a part of hospital service paid for directly by the patient.

Once the total Provincial sharable cost has been determined, it is divided by the Provincial population for the per capita cost of hospital services in the Province. Twenty-five percent of this cost and of the Canadian per capita cost are added and then multiplied by the average number of insured persons reported at the end of each month in the year, to arrive at the Federal Government's contribution. In Provinces where the Provincial share is financed through sales tax or general revenue and coverage is universal, the number of insured persons equals the Province's population as estimated by the Dominion statistician. In the premium Provinces—particularly in Ontario, where coverage is partially optional—the insured population must be estimated from enrollment records. At the Federal level, the Canadian per capita cost, which includes all of Canada, is computed from the consolidated returns of all participating Provinces and estimates for the nonparticipating Provinces and Territories.

Hospital Care

The foregoing section should not be allowed to leave the impression that the main emphasis of the Canadian program is financial. All the costing details relate ultimately to the primary purpose of the act—furthering the provision of hospital service in the Provinces.

The actual quality of hospital care provided under the program must constitutionally remain a Provincial responsibility. There is no Federal intervention in hospital management, other than the requirement that Provinces arrange satisfactorily for supervision, licensing, and inspection of hospitals and "make such arrangements as are necessary to ensure that adequate standards are maintained in hospitals" (3).

However, institutions scheduled in the Provincial agreement as hospitals for purposes of cost sharing under the act must be approved by both Provincial and Federal authorities. It is clearly in the interests of the Provinces, as

well as the institutions themselves, to have as many marginal hospitals upgraded to meet Federal requirements as possible. This is expected to be effective particularly in the area of long-term care establishments which might more strictly be defined as nursing homes, but which can provide the type of care for chronic and convalescent patients required by the act. Two such establishments in Peterborough, Ont., were licensed as chronic hospitals for purposes of the act, although most other nursing homes in the Provinces were found to lack the necessary facilities for consideration under the program at present. Parts of institutions that might otherwise be excluded, for example, tuberculosis sanatoriums, many of which now have unoccupied beds, have also been licensed for general care in some parts of Canada. The list of scheduled hospitals and facilities in each Provincial agreement is subject to frequent revision and amendment.

In all Provinces where hospital insurance programs have been newly established, the expected increase in demand for bed space has materialized to some degree. Figures are not as yet available, but nowhere has the shortage of hospital space amounted to a crisis. A part of the increase is expected to be temporary, caused by persons who postponed treatment to take advantage of the new insurance, especially in Provinces such as Ontario where details of the plan were publicized for many months before the plan became effective.

The Ontario Medical Association and others have organized medical staff committees to review admissions and discharges. Some Provinces have had to embark upon an expansion of hospital facilities in order to provide the contracted services. Nova Scotia, for example, had an estimated shortage of 2,000 beds at the time the program came into effect, but with aid from an expanded health grants program has already made up 1,300 of this deficiency. Each Provincial agreement is required to outline the Province's plan for organized expansion of facilities in the future, an incentive to the orderly development of Provincial hospital service.

The Health Field

An account of the way in which the new hospital insurance program has fitted into the

Canadian health picture would not be complete without mention of how it affects other Federal health programs and voluntary health insurance.

The health grants program, inaugurated in 1948, is the other major Federal health program. It provides Federal funds and technical assistance to the Provinces for specified health projects and has expanded continuously since its inception (6). The purposes for which the grants are made, together with amounts appropriated for all Provinces in 1959 (7), are:

<i>Purpose</i>	<i>Amount (in millions)</i>
General public health.....	\$8.5
Tuberculosis control.....	4.2
Mental health.....	7.2
Venereal disease control.....	.5
Crippled children.....	.5
Training of health personnel.....	.5
Cancer control.....	3.6
Public health research.....	.5
Hospital construction.....	17.4
Laboratory and radiological services.....	8.5
Medical rehabilitation.....	1.0
Child and maternal health.....	2.0

These grants continue alongside the new hospital insurance program, except that some of them which cover services now a mandatory part of Provincial hospital insurance plans, for example, laboratory and radiological services, now go only to nonparticipating Provinces. Most of the grants are made for specified projects which are subject to Federal approval. In most cases, each Province is allotted a maximum amount under each category of health grant, with provision being made for transfer from one category to another of any surpluses left over.

The grants for hospital construction were doubled shortly before national hospital insurance came into effect and extended to cover costs of constructing interns' quarters and renovating old premises. They now provide approximately \$2,000 Federal funds per bed, with a requirement for Provincial matching.

Some services optional to the Provinces under the hospital insurance program may alternatively be eligible for assistance under the health grants program. For example, several Provinces have chosen to continue rehabilitation programs under the terms of the health

grants program because in this way the programs can be restricted to certain needy groups of beneficiaries; if these activities were included in the hospital insurance program, they would have to be universally available to all residents of the Province.

The medical profession in Canada endorsed the hospital insurance program, guided largely by favorable reports from its members in British Columbia and Saskatchewan who had worked under Provincial hospital insurance plans for some years. Hospitals appear to have reacted favorably. In Quebec, there is reported to be considerable pressure from hospitals for entry into the program, and it is expected that ultimately Quebec will join, making the program truly national in scope.

As might be expected, a radical change has been wrought upon the voluntary hospital insurance picture. At the end of 1957, before the program came into effect, about 7.7 million Canadians had some hospital insurance coverage under private or nonprofit plans. With allowance made for duplication, this accounted for about 52 percent of the population exclusive of Saskatchewan and British Columbia, where compulsory hospital insurance plans were already in effect (8). As of January 1, 1959, the date the Ontario and Nova Scotia plans came into operation, nearly 11 million persons, or 67 percent of the population, were eligible for benefits under the new national hospital insurance program. By the end of 1959, the only Canadians not eligible for benefits will be the 4.6 million who live in the nonparticipating Province of Quebec.

Private insurers and Blue Cross plans continue to write hospital insurance for service above ward level in most Provinces. In Ontario, indeed, the hospital commission has offered to collect premiums for private and nonprofit insurers to facilitate this extra coverage. The new pattern is not yet sufficiently established to know how many persons will purchase additional insurance, but, as an indication, in British Columbia in 1957, about 6.6 percent of the population was covered by voluntary hospital insurance for preferred accommodation in addition to basic Provincial coverage (9). Voluntary insurance for surgical and medical expense is, of course, unaffected.

Blue Cross, as such, has virtually disappeared in most of Canada. However, the disappearance may be more in name than in fact, because the personnel, records, and experience have in most cases been absorbed directly into the new Provincial hospital organizations. In Ontario, for example, the 500 employees of the old Ontario Hospital Association's voluntary plan have all been transferred to the new Ontario Hospital Commission and continue to perform the same function on a larger scale.

The new hospital insurance program has been called by one Federal official "the most significant development in the health field in Canadian history" (4). It clearly goes far toward meeting what Hon. J. Waldo Montieth, Minister of National Health and Welfare, termed "the obvious needs of Canadians for an orderly and economic means of obtaining basic hospital care" (10). Because of the close similarities between Canadian health needs and our own, the further development of this experiment will bear close watching from the United States.

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Grants for Extramural Research in Nursing

Ten new awards, totaling approximately \$250,000, have been granted for extramural research in nursing by the Public Health Service, bringing to 73 the total of grants awarded under the nursing research grants program since its inception in 1955. Awards to persons outside the Service for studies on nursing and improvement of patient care, now amounting to \$3 million, are administered by the Division of Nursing Resources in cooperation with the Division of General Medical Sciences of the National Institutes of Health.

The recent awards are for studies on cardiac and psychiatric nursing, nursing education (including improvement of research competence), and the educational and socioeconomic factors affecting nurses.

Stream Life Below Industrial Outfalls

WILLIAM MARCUS INGRAM, Ph.D., and W. W. TOWNE, M.S., C.E.

The following brief review of present knowledge of the biological effects of industrial wastes in water is offered in anticipation of publication of a detailed book on this subject. The text will cover methods of presenting biological data (touched on here) and sampling equipment indicated for stream surveys. It will carry a full bibliography. Only a few outstanding references are cited in this article.

THAT DAY is dead when it seemed only natural and logical for Americans to discharge raw industrial wastes to the most convenient stream. The recognized need to protect the Nation's basic and essential water resource has brought all artificial additions to the stream under critical scrutiny. The present task is to establish reasonable appraisals of the various effects of specified industrial effluents. Conversely, we seek to learn how certain biological effects may serve as indicators of forms or degrees of industrial pollution in a stream.

What are the outstanding detrimental effects of industrial wastes on aquatic life? How do certain nutrient wastes contribute to the growth of biological nuisances? Comments on these questions are offered with confidence that they will be viewed in the large perspective that embraces all forms of stream pollution, including those provoked by improvident abuses of the

Dr. Ingram is in charge of biological field investigations, Field Operations Section, and Mr. Towne is deputy chief of the Technical Services Branch, Division of Water Supply and Water Pollution Control, Robert A. Taft Sanitary Engineering Center, Public Health Service. The full paper on which this article is based was presented at the 14th Annual Purdue Industrial Waste Conference in May 1959 at Purdue University, Lafayette, Ind.

land, excessive use of water, and failure to regulate streamflow. The contribution of domestic sewage and the scouring effects of peak flows also are assumed as being understood in the general context of these remarks.

The major emphasis here falls on four factors in industrial wastes that are responsible for the most subtle environmental effects: elevated temperature; particulate matter, contributing to turbidity and the formation of settleable solids; nutrients, favoring blooms of aquatic weeds and pests; and radioactive elements. These conditions in turn produce forces damaging to the productive use of the water resources.

Elevated Temperatures

The effect of a mild heating of natural waters, its influence on the metabolic processes of biota as reflected in measurements of oxygen demand, oxidation, and reaeration, has long been recognized, if not fully understood. As temperature of water rises, oxygen becomes less soluble. Under a pressure of 760 mm. in fresh water, the concentration of dissolved oxygen at 0° C., is 14.62 ppm; at 20° C., 9.17 ppm; at 39° C., 7.63 ppm. The mere heating of a stream can deny stream life its normal supply of oxygen. Coupled with putrescible pollution, which increases the total demand for oxygen, a rise in temperature may deplete the oxygen level to a stage of asphyxiation for aquatic organisms, which cannot survive in such competition.

Another subtle effect of a rise in temperature is reflected, on occasion, in the increased toxicity of certain chemicals. For example, exposed to 0.4 ppm rotenone, brown trout die in 15 minutes at 21.11° C., in 70 minutes at

12.78° C. With dosage of 0.2 ppm, they die in about 22 minutes at 21.11° C. and in 100 minutes at 12.78° C. (1). But this gain in toxicity with heat is not the rule for all chemicals or species. At 10° C. and 25° C., there is no observed change in the toxicity of ammonia to chubs. Further, it has been demonstrated that toxicities of potassium dichromate and naphthenic acid were similar at 18° C. and 30° C.

For students of the effects of temperature on fish, laboratory studies offer a wealth of data which cannot be summarized here, but several such summaries are in the literature (2,3). J. R. Brett's "Some Principles in the Thermal Requirements of Fishes" is an especially useful and comprehensive review of this subject (2).

In industrial waste field surveys of large streams, it may be difficult to relate detrimental effects of temperature (heat pollution) to specific aquatic organisms. In bodies of water, such as the Mahoning River in Ohio, where temperatures become high enough to be lethal to most aquatic organisms in outfall areas, deleterious conditions arise also from other factors, such as low dissolved oxygen, high turbidities and settleable and floating solids, and pH and chemical toxicity.

Hot industrial discharges can be disastrous to fish. Also, high temperatures may alter the entire biosphere. By eliminating many organisms, heat may allow a few, such as the heat-resistant blue-green alga, *Phormidium*, to become dominant. Ranges in which algae are known to grow best in general are from 18° C. to 30° C. for diatoms, 30° C. to 35° C. for greens, and 35° C. to 40° C. for blue-greens. Some species grow at even higher temperatures (4). Gross limits of temperature (5) that most warm-water fish experience in natural bodies of water are somewhere between 0° C. and 35° C. (32° F. to 95° F.). If water of 30° C. is available, warm-water fish may seek it, leaving 32° C. water. Among warm-water fish are sunfish, catfish, carp, and many minnows. Cold-water fish, such as the salmonoids, salmon and trout, normally live in natural waters that range between 0° C. and near 18.34° C. (summer temperature). They usually do not tolerate temperatures above 27.23° C. Certain trout have been reported as surviving temperatures of 27.78° C. to 28.34° C. for very

short periods in natural water (5,6). The Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission, referring to waste discharges, recommended that temperatures not be raised above 34° C. (93° F.) "at any place at any time," and stated that temperatures during December through April should not exceed 23° C. (73° F.) "at any place or at any time" (7). The report emphasizes that natural temperatures must be maintained in streams suitable for trout propagation.

No one knows precisely how varying temperatures affect all the biota of a stream. However, in general, it appears that in most temperate zone streams of low gradient, large reaches should not exceed 30° C. for prolonged periods, and that headwater streams ought not be warmer than the top range of 22° C. to 25° C. for extended periods. Further research is more likely to reduce than raise these limits (8).

As examples on record of streams affected by high industrial heat discharges, one can mention the Mahoning River in the Warren-Youngstown, Ohio, reach; the Kentucky Lake site of the New Johnsonville steam plant, Martins Creek, Pa., site of the steam-electric generating plant on the Delaware River west bank several miles downstream from Belvidere, N.J.; and the waters near the Front Street power station at Erie, Pa.

Temperatures in the Mahoning River have exceeded those tolerated by fish and other aquatic organisms. The "Ohio River Pollution Control" document prepared by the Public Health Service states, "During periods of low streamflow the water temperature below Youngstown has risen often to over 43.34° C." (9). It is reported in "Water Resources of the Mahoning River Basin" that, when the last of four reservoirs went into operation, flows have been such that the maximum daily temperatures have only occasionally been above 37.78° C., and that monthly mean temperatures have been below 36.66° C. (10). During a survey in July and September 1952 of the Mahoning (Pricetown to Lowellville reach) in which Ingram participated, maximum temperatures for 12 stations occurred in September and were 35.1° C. at Struthers and 34.5° C. at Lowell-

ville. Seines and various dip nets in the reach of the Mahoning from below Warren through Lowellville in September 1952 failed to take fish when industry was discharging wastes, including hot water, in addition to raw municipal sewage. At this time, several chemical and physical factors, in addition to heat, could have been considered equally lethal or detrimental to fish, for example, pH as low as 2.4, dissolved oxygen as low as 0.2 ppm, and various high concentrations of industrial and municipal sewage solids.

In July during the extended steel strike, when pollution was largely produced by raw domestic sewage, although there were also residual industrial effects, fish were taken at Girard and above Indian Run Creek in Youngstown. At Girard temperatures varied from 23.5° C. to 29.5° C.; dissolved oxygen varied from 5.0 to 5.6 ppm; and pH from 6.9 to 7.4. Northern creek chub and goldfish were taken at Girard. Fish taken at the Indian Run Creek station under comparable temperatures and pH and dissolved oxygen ranges were the large-mouth black bass and the common shiner. At upstream control stations above Leavittsburg in July and September, with stream temperatures varying from 24° C. to 31° C., the dissolved oxygen from 5.7 to 6.9 ppm, and the pH from 7.0 to 7.6, sampling obtained a variety of fish: white crappie, small-mouth black bass, northern creek chub, green sunfish, northern black bullhead, bluntnose minnow, and golden shiner.

A field survey of the fisheries related to heat discharged by the New Johnsonville steam plant on Kentucky Lake indicates that a localized warming effect, over that of contiguous waters in the impoundment, served to attract fish and help them survive during cold-water periods (11). Warm water from the steam plant may serve as a winter refuge for threadfin shad. These fish abounded in the steam plant discharge harbor, warmed by condenser water discharges to 12.78° C., when other water of Kentucky Lake was 7.22° C.

Information on the effects of hot condenser water discharged from a steam-electric generating plant to Martins Creek, Pa. (which, in turn, feeds heat to the Delaware River), so far has been inconclusive (12). These studies are continuing. An example of temperature

dissipation in the area of the Delaware illustrates how rapidly temperature can be dissipated in a flowing stream, although the situations described are never exactly repeated. At a railroad bridge 1,500 feet below the heat source, the maximum temperature was 32.22° C., at 2,000 feet 30° C., at 2,750 feet 22.78° C., at 3,600 feet 21.66° C., and at 4,500 feet 20° C. The initial temperature of discharge water is not available.

Particulate Matter

Turbidity, which is considered to be an expression of the optical property of water which causes light rays to be scattered and absorbed rather than transmitted in straight lines, is increased by various forms of particulate matter in suspension (fig. 1). Such matter may include phytoplankton or zooplankton cells, such as algae and protozoans, or silt or other fine materials. Particulate matter in any form that settles to form organic or inorganic sludge is described here as "settleable solids." These solids include matter which increases turbidity.

Many industrial operations contribute settleable solids to water. Apart from the chemical activity that may be provoked in water by such particulate matter, the physical effects on aquatic life are often severe. Some industrial discharges of particulate matter are coal and other mineral products, including washery by-products; glass sand; lumber; aluminum, steel, and other metals; pulp and paper; wastes from slaughterhouses, canneries, tanneries, and dairies; and oil.

Since such wastes in suspension limit the penetration of sunlight, they impede the growth of aquatic plants attached to the bottom as well as floating or weakly swimming algal forms. Being photosynthetic, these organisms depend on light for existence. Solids also floc planktonic algae and even surface animals and carry them to the bottom to die. By limiting growths of aquatic plant meadows, the wastes starve organisms which feed there. The food chains are interrupted, and aquatic life in general becomes sparse.

As particulate matter settles, the deposits can blanket the substrate. Such a physical en-

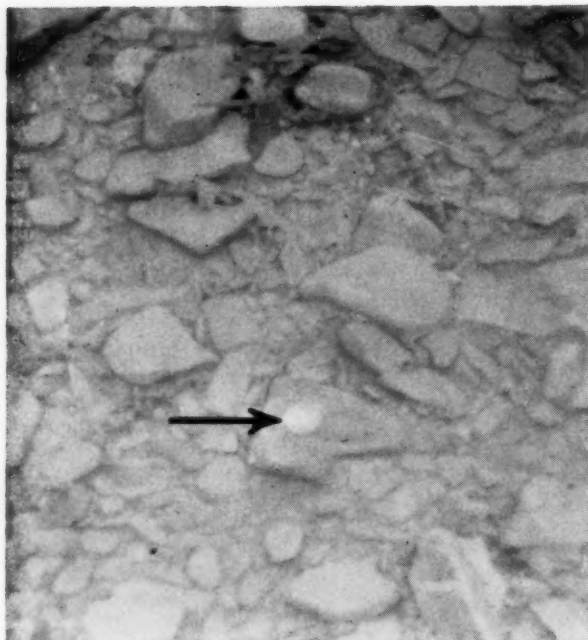


Figure 1. Stream turbidity

(Left) Arrow points to a dime in clear water of Potomac River with low turbidity. (Right) Dime is obscured by high turbidity resulting from inert particulate matter discharged from an industrial operation.

vironment is unacceptable to organisms that would normally occupy such a habitat. Not only industrial wastes but also silt produced by soil erosion is said to alter aquatic environments, chiefly by screening out light, by changing heat radiation, by blanketing the stream bottom, and by retaining organic material and other substances which create unfavorable conditions at the bottom. Also, it has been stated that the developing eggs of fish, as well as fish food organisms, may be smothered by deposits of silt (13). Direct injury to fully developed fish apparently by nontoxic suspended matter has been demonstrated only in tests with concentrations which are uncommon (3).

Quite different physical effects on stream life result if the bottom blanketing deposits are dominantly organic rather than inorganic. If they are not highly toxic and if the supply of dissolved oxygen is satisfactory, soft organic sludges will give rise to organisms adapted to that environment. On the other hand, inert solids, such as glass sand and other mineral wastes, destroy bottom life. Fewer organisms can live among compacted, heavy abrasives characteristic of such wastes. These wastes may actually simulate "ball-mills," grinding

and crushing life that is contacted on a stream bottom, as they are resuspended and moved downstream by periodic surges of high water.

The physical effects of organic sludges of industrial origin are partially illustrated in figure 2, describing a hypothetical situation based upon specific data gleaned from field investigations. It is assumed, for this discussion, that the deposits are not appreciably toxic and that the dissolved oxygen resources are adequate for aquatic life. Settleable solids enter the stream at mile 0 and organic sludge deposits of maximum thickness are formed in the zone of active decomposition between miles 12 and 48. Turbidities are highest between miles 0 and 12. Sludge deposits are not significant elsewhere, and turbidities elsewhere are also unimportant.

In the clean water zones, the bottom is composed of small and large stones. Here a multitude of different species of bottom organisms, plankton, and fish abound. Typical of the species on this bottom are caddisfly larvae, stoneflies, mayflies, hellgramites, gill-breathing snails, and unionid clams. There are many spots where fish may nest. Small-mouth black bass, sunfish, and various minnows flourish on

a rich diet of insects which, in turn, enjoy numerous algal species. The main observation is that there is a great variety of species represented by a few individuals of each form.

In the zone of degradation, floating solids blanket out the light penetration. Moving into the zone of active decomposition, as these solids settle, sludge blankets the entire bottom. Turbidity makes the water almost opaque. Only a few species can survive in the soft, shifting sludge. Being isolated from most competitors and predators, a few species here form huge populations. The few animal forms that thrive in a sludge substrate are bloodworms, *Tubifex* and *Limnodrilus*; water sow-bug crustaceans, *Asellus*; certain left-handed snails; and various leeches. Fish are absent or scarce. They prefer to nest elsewhere. Aquatic plants are not able to root. Species of algae are extremely limited: blue-greens, such as *Phormidium* and *Oscillatoria*, form gelatinous slimy blankets over the sludge in shallow marginal water. Only an occasional plankter moves

through the water in the zone of active decomposition; most have been dragged out of the upstream water in the zone of degradation to suffocate in the clinging wastes.

A detailed description of a bottom covered with inert inorganic solids suggests an aqueous desert rather than the jungle of bloodworms found in organic sludge. Data collected in September 1952 (fig. 3) and again in September 1958 portray the physical effect on aquatic life of waste from a glass-sand operation on a small creek feeding the Potomac River. Below this creek reaches a submarine Sahara, dotted with a few rare oases. In 1958, above the point of confluence, the Potomac was sparkling clear, bedded by a bottom of rocky ledges, rocks, coarse gravel, and some natural clean sand, lush with beds of higher aquatic plants, such as *Elodea* and *Potamogeton*. Gill-breathing snails and mayflies dominate invertebrate life everywhere on the substrate. Large unionid, pearl-button clams dot the margin. Minnows swarm in the sunlight. The filamentous alga, *Clado-*

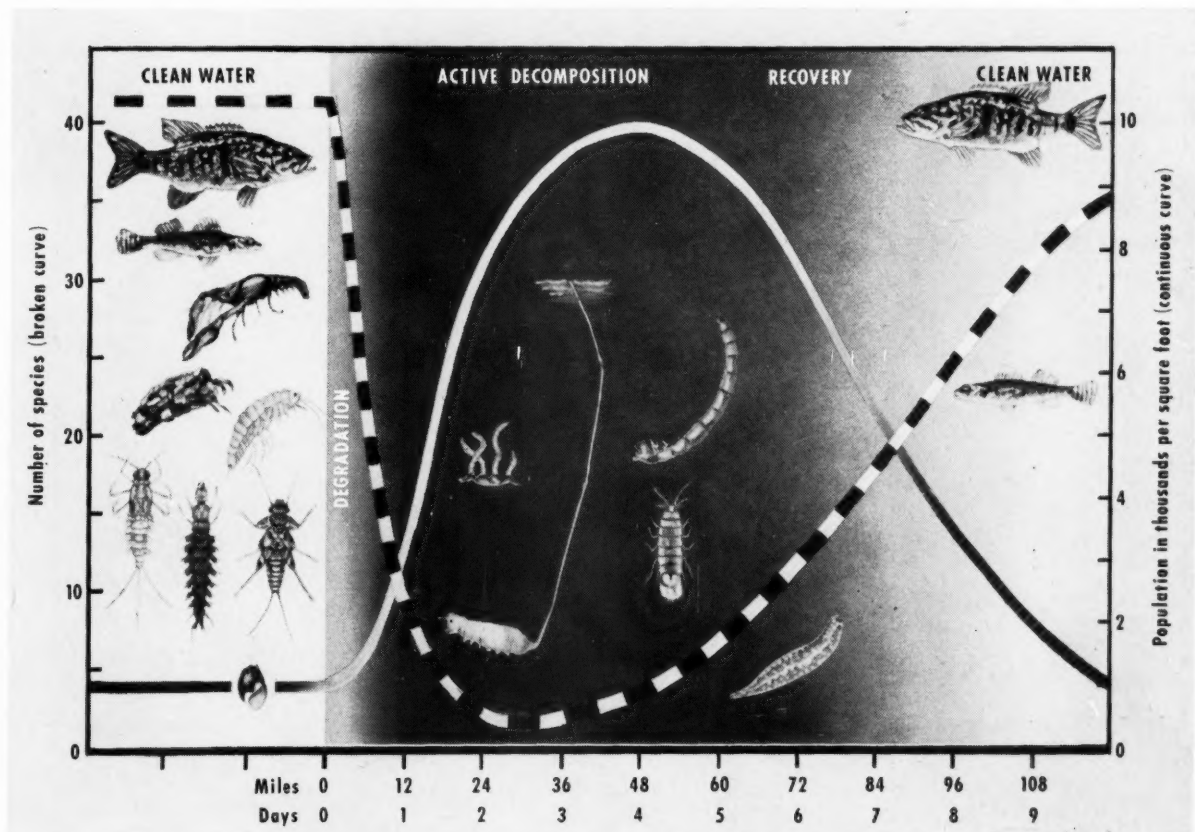


Figure 2. Biological effects of organic sludge

phora, covers much of the rocky area. Eleven genera of planktonic and filamentous algae and eight genera of animals are represented in our collections from this station.

At a station 600 yards below the confluence of the small creek (receiving glass-sand wastes) with the left bank of the Potomac, the bottom of the river was devoid of life in 1958, as it was in 1952. Blue-green algae grew marginally on the wave-wash area of the bank. This paucity of organisms extended to midstream, where 3 genera of snails and 10 genera of planktonic algae were collected. From the left bank (looking upstream) to the midstream rocky ledges, the rocks, gravel, and sand of the original Potomac River bottom were covered completely up to 2 feet deep by waste glass-sand fines. During the period when samples were collected in 1958, the sand fines desert was spectacular in clear water. Turbidities attributable to this operation were found to vary tremendously in 1958 with waste discharges, from 130 turbidity units to 50,000 turbidity units. The effects of such discharges in 1958 were observed to suppress bottom life as far as 10 miles downstream.

Excess of Nutrients

Overproduction of any plant or animal is a sign of an unbalanced ecology. The degree of disequilibrium may be a portent of disaster as when a rise in human population taxes a land's limited natural resources. Likewise overpopulation of a lake with shad may present a sudden and unwelcome abundance of protein at the shore.

Wastes with substrates of nitrogen, phosphorus, carbohydrates, and fats may have the potential of forming through hydrolysis in enzymatic systems, readily available end products of organic foodstuffs such as amino acids, simple sugars, fatty acids, and glycerol. These feed animals or stimulate aquatic plant growth. Such wastes may build up such a plant or animal nuisance growth that water uses are impaired. Organisms that flourish typically with certain of such nutrients are the sewage bacterium, devil grass (*Sphaerotilus*), and certain planktonic and sessile algae.

Algal and *Sphaerotilus* blooms that interfere

with multiple uses of water result from a nutritional process that is not immediately relevant. However, the damage they do is likely to continue, and other nuisances may ensue. If streams, lakes, and manmade impoundments continue to be enriched with wastes of industrial, municipal, and agricultural origin, biological nuisances will be intensified and new unspoiled areas will suffer.

Sphaerotilus, the filamentous-plumose flocc-forming bacterium, is not now susceptible to control. Research has not revealed treatment methods that have been productively put into operation on a plant-scale basis, either to prevent or eliminate the growth, despite the best efforts of the pulp and paper industry to foil this gelatinous pest (14, 15).

Sphaerotilus abounds in certain reaches of the Columbia River in Washington and Oregon; Altamaha River, Ga.; Hiawasee River, Tenn.; New River, Va.; Penobscot River, Maine; Clearwater River, Idaho; Fox and Menominee Rivers, Wis.; and Bear River, Utah.

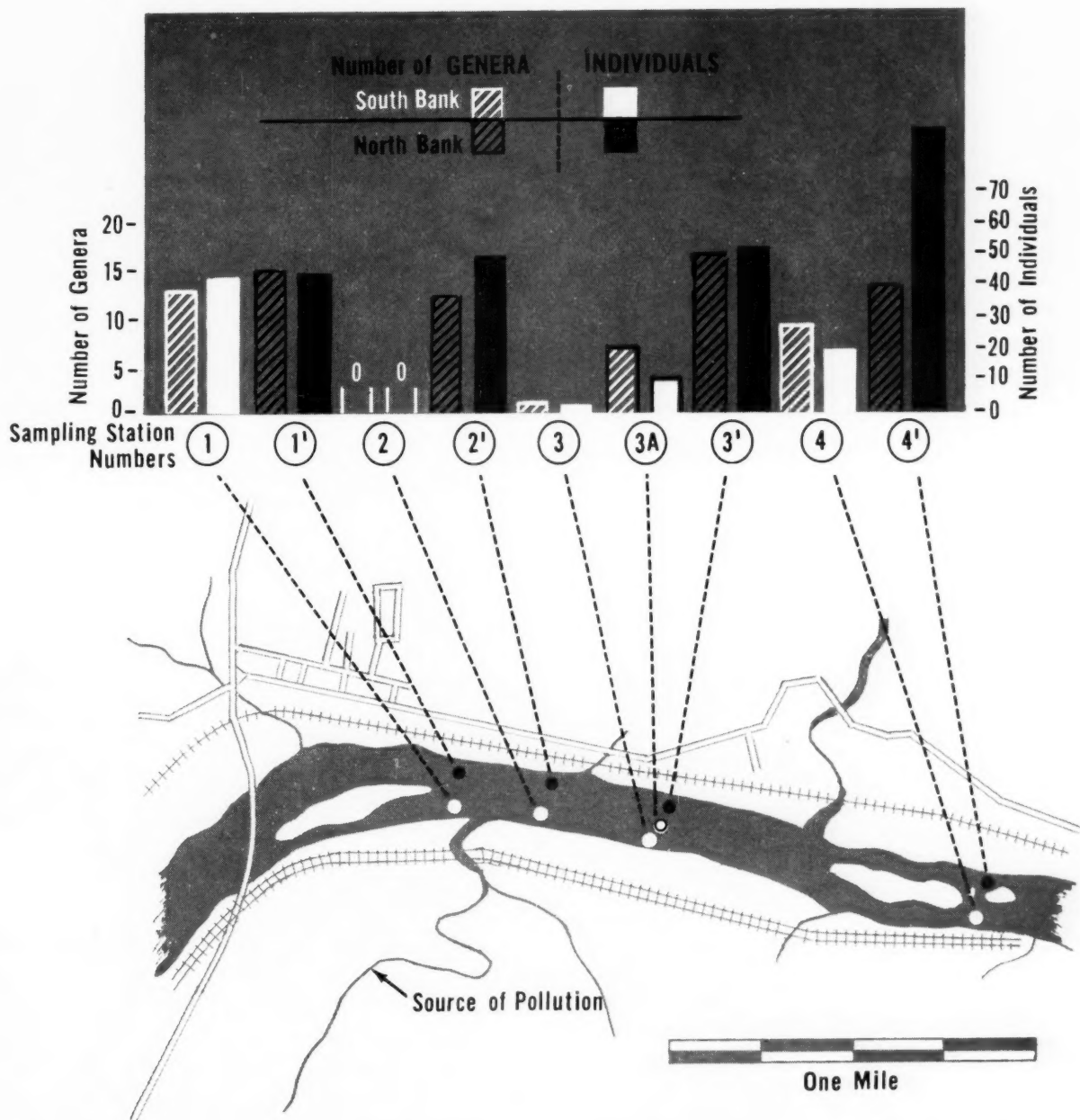
It occurs in restricted patches in the Connecticut River, Mass.; Ohio River, downstream from Cincinnati, Ohio; Grass River, N.Y.; Potomac River drainage in Maryland; South Holston River, Tenn.; as well as in smaller streams throughout the country.

Without an inventory to indicate the current abundance of *Sphaerotilus* in waterways of the United States, there can be no valid assessment of its distribution and the magnitude of its nuisance value. Too, only such an inventory can relate the subtlety of its development to bloom proportions to nutritional substrates from various types and combinations of waste and runoff.

Sphaerotilus has become recognized as a pest in recent years principally because of its interference with both commercial and sport fishing. Its effect on the gill-net commercial fisheries of the Columbia River is notorious. Specific complaints have been voiced also by fishermen on the Altamaha River in Georgia and the New River in Virginia. The major realistic objection is that *Sphaerotilus* flocs, entangled in fishing gear, hinder the catch and add to the work (16).

Sphaerotilus, in forming blooms, especially

Figure 3. Physical effects of glass-sand operations, Potomac River, September 1952



NOTE: This pictorial map combined with vertical bar graphs showing variations in bottom animals per square foot in a section of the Potomac River illustrates use of a graph to demonstrate the impact of pollution on aquatic life, replacing a long list of names of animals and plants found in an affected stream. The presentation shows sampling stations in relation to roads, railroads, and towns. The effects of inert, inorganic solids in limiting the number of animal genera and individuals (stations 2-4 on the south side of the

river) are compared with their abundance at stations in unaffected stream areas (1 on south side and 1'-4'' on the north side). Stations 1 and 1' are used as controls. Solids are carried into the main river from the tributary at the confluence between stations 1 and 2. Bottom animals are absent at downstream station 2. Only 1 genus was collected at station 3 on the south half of the bottom, while 7 genera were taken in the center of the river (3A) and 16 genera on the bottom of the northern half of the stream (3').

in riffle areas with other associated bacterial slimes, may blanket the bottom, "crowding out" fish food organisms and spoiling potential fish nesting areas.

Prospective difficulties from *Sphaerotilus* are: (a) clogging of rapid sand filters of municipal and industrial water treatment installations, (b) tastes and odors in water produced by decay, (c) mucilaginous nuisances in pumping stations and in irrigation canals, and (d) contact nuisance to swimming, water skiing, and boating.

The process by which excess nutrients are released to create algal and rooted aquatic plant nuisance growths can be diverted rather than inhibited. In modern waste treatment practices, dissolved inorganic or mineral constituents of municipal sewage and industrial wastes are removed only incidentally by sedimentation and oxidation. Also certain organic materials are broken down, with treatment, to liberate inorganic nitrogen and phosphorus. Treatment plant effluents may actually contain more readily available nutritional substrates than are found in raw sewage effluents. In order to limit the fertilizing effect of sewage and of certain nontoxic industrial wastes, such wastes ideally should be excluded from natural lakes and impoundments. Despite exclusion of nutrient-bearing wastes, agricultural drainage, carrying nitrogenous and phosphorous compounds, will especially provide nutrients that may encourage green aquatic plant nuisances.

It has been shown that, if assets of inorganic nitrogen and phosphorus exceeded 0.30 and 0.01 ppm, respectively, at the start of the active growing season (the time of spring turnover in northern climates), a season with nuisance algal blooms could follow (17). This suggestion was made following 2 years of study on 17 lakes in southeastern Wisconsin. While it does not apply to all lakes, it has stimulated other investigations.

The facts today indicate that, with continual nutrient enrichment of waters, algal nuisances have only begun to demonstrate what they may become in future years. Domestic sewage alone may vary in its nitrogen content from 15 to 35 ppm and in phosphorus from 2 to 4 ppm (18). In relation to these nutrients, it has been stated:

"A large percentage of these fertilizing elements exists in a readily available condition or becomes so during biological treatment or while undergoing stabilization by microorganisms in the receiving body of water. Consequently, it can be reasoned that sewage contains nitrogen and phosphorus in a ratio of about 8 to 1" (18). Data on increments of nitrogen and phosphorus from various industrial operations are not at hand but the total contribution of industrially produced chemicals offers many complications to the biochemistry of the water resource.

Specific contributions by agriculture of nitrogen and phosphorus to bodies of water by runoff are not known. However, data provided by the U.S. Bureau of Reclamation points to increments of nutrients in the soil. A 1955 estimate of an average use of fertilizer per irrigated acre in California is 382 pounds, of which 42 pounds per acre are nitrogen and 26 pounds per acre are P_2O_5 .

The effects of algal nuisances have long been known to the waterworks field. Algal blooms cause tastes and odors in water, clog rapid sand filters, and form unsightly scums on basins in water treatment installations. In future years, those charged with management of water projects, such as the many multiple purpose reservoirs that are being constructed in this country, are likely to encounter a variety of biological nuisances, especially algal blooms nurtured by nutrients introduced by man. In summarizing information on European lakes, the data suggest the potential biological nuisance that can arise, with time, in our reservoirs (19). But little has been published on lake fertilization (eutrophication) to show systematically the effects of nutrients on the lake ecology and on the uses of lake water.

Lake Zurich, Switzerland, composed of two arms connected by a narrow channel, less than 100 years ago is stated to have been clear and clean, supporting trout and whitefish. Since the turn of this century, urban drainage from small communities totaling about 110,000 persons has been discharged to one arm of this lake. Beginning in 1896, algal scums formed that were malodorous as well as unattractive. The lake ceased to be enjoyed for bathing, boating, and general recreation. The cities and in-

dustries that used lake water had to install expensive "filtering and purifying systems" to remove the organic matter and overcome obnoxious tastes and odors. Oxygen in the deeper water declined so that trout and one species of whitefish disappeared, and two other species of whitefish became scarce. Other species, largely coarse, replaced the sought-after game fish. The shallower basin, Obersee, which received no urban drainage, is reported to have retained its "virgin-lake" characteristics and has changed but little. Unwitting fertilization not only causes nuisances, but hastens the extinction of a lake by accelerated sedimentation, according to records for 37 lakes in the United States, Austria, England, Finland, Germany, Italy, and Sweden. In these lakes, eutrophication within several decades has entailed disagreeable consequences similar for the most part to the events in Lake Zurich (19).

Effects on lakeside dwellers have been well documented for algal blooms on certain lakes near Madison, Wis. Especially during hot summer periods, lakes assume the appearance and consistency of thick green pea soup. At such times, the reaction of bathers, sailors, and fishermen may be imagined. The unsightly masses of green as they decompose, also produce vile odors that make life in the area hardly tolerable (20).

Algal blooms have been responsible for massive fish kills by reducing the resources of dissolved oxygen. During daylight hours, algae and submersed aquatic plants give off oxygen by photosynthesis, commonly raising the dissolved oxygen resources to supersaturation levels. But photosynthesis does not proceed during hours of total darkness although respiration continues. In streams with huge algal blooms, dissolved oxygen in these circumstances may be reduced below survival points. In Lytle Creek, Wilmington, Ohio, dissolved oxygen fluctuated over 24 hours from 19.4 ppm in the afternoon to 0.7 ppm before dawn. A fish kill in this creek was attributed to oxygen depletion, largely by algal respiration (6). Fish kills under similar conditions have been reported for East Okoboji Lake and Storm Lake, Iowa (21), and other such disasters have occurred in the Ohio River Basin (22).

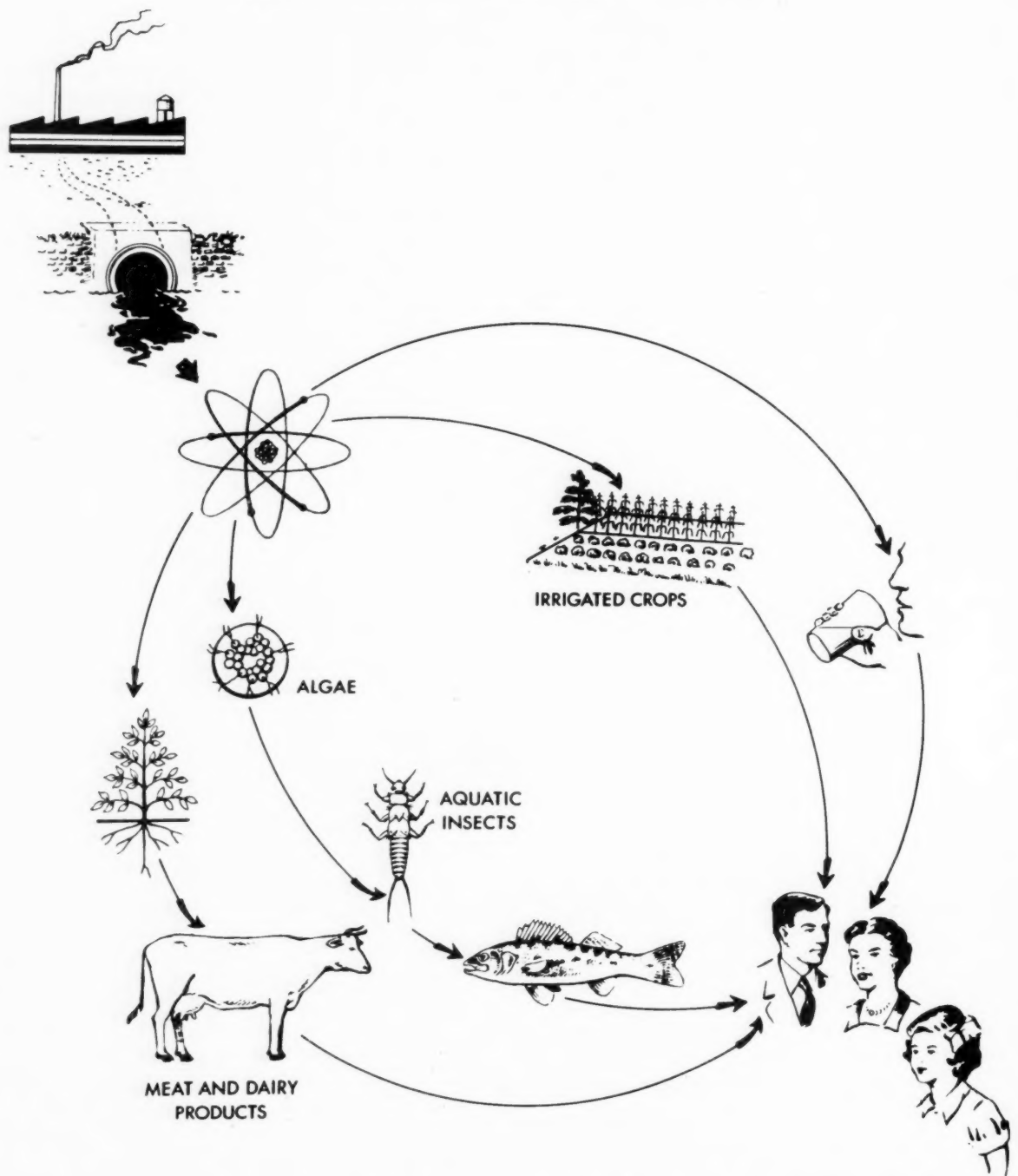
Radioactive Wastes

Recommendations as to maximum levels of radioactivity in water or aquatic organisms are outside our province, except for the general acceptance of the principle that any addition to the prevailing burden of radiation should be judiciously considered, and that unnecessary additions be eschewed. Rather than evaluate the effects of given quantities of radioactivity, this discussion is confined to the quality or character of the process by which certain nuclides, through biological adsorption and absorption, are cycled into human food chains, as shown in figure 4 (23). By such processes, radioactive atoms are concentrated to relatively high orders of magnitude by organisms living in blooms in natural waters.

Concentration of radionuclides in edible fish and their subsequent lodging in human tissue is readily visualized. Less obvious is the potential transport of radionuclides into human tissues after algal blooms have increased the concentration in raw-water sources. Even though such blooms are caught on rapid sand filters and backwashed to carry them out of the drinking water supply, there remain opportunities for radionuclides to pass through the filters into finished water. As algal cells fragment on filters, they may release atoms in solution in the drinking water. Also, water supplies without treatment other than chlorination can carry algal cells with adsorbed and absorbed radionuclides directly into the drinking water supply.

Davis and Foster have cautioned that the recommended maximum concentrations of radioactivity in water do not in themselves limit the degree of biological concentration: "With an increasing number of atomic energy installations and their associated problems of disposal of liquid wastes, we recognize that more and more aquatic environments are going to be exposed to at least low concentrations of radioactive materials. For the safety of human populations who may be drinking water which contains such radioactive materials, a set of maximum permissible concentrations has been recommended (International Commission on Radiological Protection, 1955). By themselves, however, such recommendations are in-

Figure 4. Radioactive wastes from water to man



Reprinted with permission of the American Society of Mechanical Engineers (reference 23).

adequate to define completely the radiological hazard which may develop through aquatic food chains. Where biological systems are involved, the organisms may accumulate certain isotopes to many times the initial concentrations in the water" (24).

The International Conference on the Peaceful Uses of Atomic Energy enlarged upon information pertinent to this discussion (25): "Extensive studies have been made of the radioactivity in river organisms below the Hanford reactors, since the radiation levels

could not accurately be predicted. Results indicate that concentration of very short-lived isotopes is of limited consequence in higher organisms such as fish. Radiophosphorus, on the other hand, is concentrated more than 100,000 times. Although the P^{32} is highly concentrated, existing amounts in the Columbia River are well below dangerous levels. Even in the most radioactive section, the young fish receive only about 0.1 rad per day from beta emitters—far less than the amount which would produce discernible damage. Both laboratory and field studies of river forms have shown no injurious effects from the presence of the reactor effluent. It is questionable that widespread decimation of aquatic populations will occur from radiation damage in situations where contamination levels in fish must remain below maximum permissible levels for human food. The difference in the activity density of Columbia River fish over that of the water, owing to the tremendous power of aquatic forms to concentrate some radioisotopes, illustrates the need for careful consideration of potential hazards prior to disposal of liquid wastes to public waters. If radiophosphorus were allowed to reach the maximum level permitted for drinking water, organisms living in the water would suffer radiation damage and the fish would be unsafe for human food. The seriousness of radioactive contaminations in an aquatic environment depends not only upon the quantities of individual isotopes which may be released but also upon the physical, chemical, and biological properties of the water. Where contamination of a river or lake may be significant, careful investigation of each particular case is essential since complex biological processes may introduce hazards not included in such conventional limits as permissible concentrations for drinking water."

For the immediate future, increased radioactivity in streams is likely to cause little apparent damage to aquatic life or human welfare. The long-range prospect, however, even on the basis of present burdens of radiation, offers no grounds for complacency or assurance.

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New Index Medicus

The indexing activities of the National Library of Medicine, Public Health Service, and the American Medical Association will be coordinated, according to plans approved by the Board of Regents of the library and the House of Delegates of the American Medical Association. The cooperative arrangement will go into effect in 1960.

Beginning with the January issue of that year, the National Library of Medicine will publish monthly issues only of a new medical index to be called the *Index Medicus*. The American Medical Association will issue annual cumulations of the index, to be known as the *Cumulated Index Medicus*.

Each monthly issue of the *Index Medicus* will contain entirely new material. The coverage of this index will be substantially increased over the present 110,000 to 120,000 articles in the *Current List of Medical Literature*.

After completion of the December 1960 issue, the library will rearrange and realphabetize by machine the contents of the year's 12 issues of the *Index Medicus*. The rearranged material will then be photographed by a high-

speed step camera, and the film copy will then be transferred to the American Medical Association for direct use in the preparation of printing plates.

In 1879, publication of a monthly index to the periodical literature of medicine, the *Index Medicus*, began at the National Library of Medicine. In 1916 the American Medical Association commenced publication of a quarterly index to medical periodical literature under the title *Quarterly Cumulative Index*. In 1927 the two publications were combined under the joint sponsorship of the library and the medical association to form the *Quarterly Cumulative Index Medicus*. Since 1932 the medical association has been solely responsible for publishing the quarterly index. With volume 60, covering the period July-December 1956, publication of the quarterly will cease.

Subscriptions for the *Index Medicus* will be handled by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.; the *Cumulated Index Medicus* will be distributed separately by the American Medical Association.

An essay on the forces of nature observed by research biologists working on the treatment of waste highlights the dramatic challenges of sanitary engineering.

Observations and Speculation on Waste Treatment Research

BERNARD B. BERGER

GILBERT WHITE, the great English naturalist of the 18th century, noted that dung dropped by cattle standing in ponds became food for aquatic insects, which in turn became food for fishes. He observed: "Thus nature, a great economist, converts the recreation of one animal to the support of another" (1).

The phenomenon of the food chain which so impressed itself on the good Reverend's attention is still of enormous interest to biologists, particularly to those working in the field of waste disposal. Certainly we have gained a great deal of sophistication in biology in the last few centuries. Our colleagues in the biological sciences speak now of ecologic systems, food chains, food webs, energy flow and balances, and material transformations. Our knowledge has been vastly extended in phenomena related to the interdependence of species and in all the subtle, delicate mechanisms by which micro-organisms react to their environments.

For approximately one-half century, our col-

leagues and our predecessors have been applying their best knowledge to creating optimum environments for the satisfactory disposal of human wastes. We now have at least a basic understanding of the biological communities on which we depend for waste stabilization. We have rational and intellectually satisfying procedures for designing trickling filters, activated sludge systems, and waste stabilization ponds for the intensive bio-oxidation of putrescible materials, and in a reasonably accurate fashion we may predict a stream's ability to assimilate such materials. Much has been accomplished, therefore, since the Reverend Gilbert White made his shrewd observation. However, it must be admitted we are still a long way from desirable control of the biological processes of interest, particularly with respect to new organics with which our microbial communities have had no experience.

In the course of our striving to understand and to control this biological action, many observations of interest have been made and we have speculated long as to their nature. In discussing some of these odd observations, what I have to say represents my own views and not necessarily those of the biologists with whom I have been associated. It is, perhaps, much easier for me, a sanitary engineer and in a sense an outsider, to speculate on this subject. This I shall proceed to do with a free hand.

Mr. Berger is chief of the Research Branch, Division of Water Supply and Water Pollution Control, Robert A. Taft Sanitary Engineering Center, Public Health Service. This paper was presented at the Manufacturing Chemists' Association meeting in Cincinnati, Ohio, March 18, 1959.

Although many of you have seen a trickling filter in a sewage treatment plant, probably few have ever run fingers through the slime covering on the filter rock, wondering what was in it and how it could be so effective and so reliable in treating highly putrescible human wastes. This organic film is obviously a filthy, slimy mess, but it holds great interest for the biologist. Dr. Bridge Cooke, our mycologist, recently completed an intensive study of the surface of trickling filters serving Dayton, Ohio, and what emerged from his report was an entrancing picture of a jungle in microcosm (2).

The slime was virtually a reproduction of the earth surface, especially with respect to the harsh competition for survival among organisms. The fungi in the slime held tightly to the underlying rock and gave the slime its structural strength. Filamentous algae likewise gave support to the slime layer. The fungi were akin to jungle trees, and the filamentous algae akin to green foliage. Broad savannahs were represented by extensive growths of surface algae. A variety of protozoa and higher animals browsed among the diverse plant life, and still others preyed indiscriminately on microscopic forms. Feeding on everything they contacted were insect larvae, worms, and snails. Here, in the slime, as in our familiar life, it is an eternal struggle for survival. Fortunately for us, the survivors represent a well-balanced energy and material flow, assuring good waste treatment.

The presence of the algae in the slime film was especially interesting. Obviously, they were thriving. Through their photosynthesis they were producing oxygen, much of which presumably remained dissolved in the film. Could this oxygen possibly be of any use in supporting the respiration of the micro-organisms feeding on the organic wastes? What gave point to this question was the common knowledge that the interface between the slime film and the atmosphere presents a barrier to oxygen movement. Here at the filter surface we have perhaps a built-in oxygen supply. Calculations based on the density of algal growth and on their normal rate of oxygen production indicated that if the entire slime film could be exposed to daylight or its equivalent, the total

oxygen requirement for stabilization of the organics could be met by algal photosynthesis alone.

Is it possible to open up a trickling filter so that every part of its surface may be exposed to daylight? There actually seems to be no good reason why novel surfaces arranged in perhaps an unconventional manner may not be used. It may well be that we have here a possible scheme for deriving another benefit from our algae, that is, growing them in a form for easy harvesting so that the high protein concentrations in their cellular material may be recovered with economic benefit. This possibility is envisaged also in the work of the University of California on oxidation ponds, or waste stabilization ponds, as a means of sewage treatment. I believe it is correct to say that a major deterrent to the application of the oxidation pond is the lack of an economical way of capturing and removing in concentrated form the algae suspended in the pond mass.

We may go beyond secondary benefits and consider the possibility of tertiary values that could result from the removal of nitrates and phosphates in solution by our algae. This is really an enormously interesting prospect in view of the increasing troubles being experienced all over the country with dense, highly objectionable algal blooms in our streams and lakes. The use of algae in special ponds to remove these minerals from sewage treatment plant effluents is under intensive study by Dr. Rohlich and his colleagues at the University of Wisconsin in Madison, and by others.

Recently I re-read that series of papers on activated sludge studies conducted by Theriault, Butterfield, McNamee, Ruchhoff, and others engaged in research at the station now known as the Robert A. Taft Sanitary Engineering Center. This set of papers is, incidentally, a classic of sanitary engineering. These engineers and scientists attempted to come to grips with basic questions of activated sludge treatment, addressing themselves to such fundamental questions as: What is activated sludge? How does it form? What is its function in waste treatment? Much sewage has flowed over the weir since then, and it is not necessary now to go into the spirited debates of a generation ago, debates on chemical oxidation versus bio-oxida-

tion, the significance of bioenzymatic action, the identification of slime-producing bacteria, and the general phenomenon of clarification. However, certain questions remain as stubbornly unresolved now as they were a generation ago.

One cannot but wonder what competitive advantage in the fight for life this jelly-like matrix called activated sludge confers on the organisms able to produce it. I put this question to our experts, physical chemists as well as biologists, and was assured that this slimy material is an excellent food-gathering mechanism. By processes of adsorption and absorption, nutrients are removed from the flowing waste and are brought within reach of the organism. This, I am sure, is true. But it is also, after all, a physical barrier to predators normally feeding on free-swimming bacteria. Does this film, therefore, provide a physical security to the organism as well as a more assured food supply? That the element of physical security is present is suggested by the work of many investigators. The following statement was made by Butterfield (3) in 1935: "Colpidium (a protozoan) added to a container of zoogaea bacteria gave slightly better BOD removal and much clearer effluent than zoogaea bacteria alone. Microscopic tests showed that the free-swimming bacteria had been eliminated."

The gelatinous matrix we also call "floc" definitely has survival value for the organisms. It protects them from their enemies while simultaneously bringing them food. In protected environments where food is plentiful, not only will the organisms survive, but they will grow fat. This is expressed in the polysaccharides composing the floc. So much is produced that, in waste treatment, we are forced to discard the great bulk of floc.

This matter of floc production and of the competitive advantages it provides recalls the discussions of about a generation ago on the physiological function of shells grown by marine animals on the ocean floor. In "Patterns of Survival" by John Hodgdon Bradley, the following is quoted from the address given in 1934 by the retiring president of the Paleontological Society. "All animals, and many plants, ingest with their water and food more calcium carbonate than they can profitably use. The problem of eliminating this surplus min-

eral material has always been most successfully solved by active living. The most energetic organisms possess light silicious or chitinous skeletons or no skeletons at all. The sluggards carry heavy shells." Competition forced the weak and lazy toward the ocean bottom where they are able no longer to cope with the involuntary accretion of calcium carbonate. "The more indolent began to grow shells."

Perhaps our friends, the slime-producing bacteria, are also indolent. This should not be surprising in view of the bountiful food supply they enjoy.

It is not really suggested that life in the slime is an easy one. The lurking predator sees to that. As a matter of fact, the predator is essential to a healthy system. Otherwise, our bacteria would grow fat, lazy, and inefficient.

Strange things sometimes happen in a treatment system, particularly when an intruder upsets the delicate balance. Last year when a maverick fungus got into the experimental activated sludge units (4), it succeeded in a very short time in exterminating a species of rotifer, minute bacteria-eating animals, important in the biological balance of the system. As a result, the stabilization process stopped dead.

It is well known that an effective biological treatment system depends on the voracity of microscopic animals. Their essential job is to keep the working microbial population fit and active. Recent discoveries suggest they play another important role by inhibiting the growth of *Sphaerotilus natans*, the so-called sewage fungus, which is associated with sludge bulking and fouls our streams. When Dr. Clarence Tarzwell was studying Lytle Creek, he found that profuse growths of this nuisance were accompanied by swarms of single-cell, microscopic animals, mostly ciliates and rhizopods (5). It appeared that the amebalike rhizopods, in particular, had keen appetite for this bacterial weed. A personal communication from Dr. H. Heukelekian of Rutgers University indicates that a rotifer with a similar function has been found.

When Butterfield was engaged in his study on the identification of organisms in the activated sludge floc, he recorded an observation which impresses me as being particularly odd. It occurred while he was trying to isolate bac-

teria from the gelatinous, zooglea matrix by washing it with distilled water. He reported as follows: "In carrying out this cleansing procedure, an unexpected phenomenon was encountered. During the course of the washing, the embedded bacterial cells would free themselves from the gelatinous matrix and move away with incredible speed, dispersing themselves throughout the dilution water long before a satisfactory washing had been accomplished" (3). Subsequent observations suggested that the bacteria had left the gelatinous matrix because no nutrient was being absorbed. The dispersing action was prevented by washing with water containing dissolved organic material. The interpretation of this occurrence is, in my opinion, simple. Bacteria have to feed continuously. When their food concentrating mechanism fails them, they are literally forced to leave their homes and go searching for food.

Butterfield's observation is of particular interest in the light of a recent report by Dr. Herman Amberg indicating that, in the laboratory, growth of *Sphaerotilus* could be prevented by substituting a schedule of intermittent discharges of pulp mill wastes for one of continuous discharge (6). Perhaps here too, the individual organisms composing the *Sphaerotilus* filaments were forced to leave their abode during the period of no discharge and seek their food by freely swimming about. Although I am not aware of any extensive observations on this point, the hypothesis is appealing.

We are slowly learning more of what goes on in the microworld of waste treatment. Eventually we may even be able to develop microbial systems to handle lignins and certain synthetic organics that presently pass through treatment practically unaltered in character or concentration. The success of geneticists in developing new strains of bacteria encourages use of their techniques in research. This goes much further than simply exposing the organisms to the organic chemicals, hoping they will, through hunger, learn how to use them as food. Bac-

teria can be trained. They have excellent capacity for adapting themselves, and they breed so fast that a mutant strain can quickly establish itself in the appropriate environment.

We are engaged in developing intelligent ways of getting micro-organisms to accept strange compounds as nutrients, shocking them if necessary into evolving the necessary appetite and digestive muscle to do the job efficiently. However, we have much to learn ourselves before we can, in scientific fashion, routinely mold microbial communities into smoothly functioning organizations for breaking down highly complex compounds.

Bacteria must feed on highly energized carbon and nitrogen compounds to satisfy growth and living requirements. They soon learn to relish most manmade compounds, even very complex ones. Others they reject, presumably because certain molecular structures are too hard to break up and digest. Perhaps, if research is sharp enough, we may be able to identify many of these barriers and learn how to overcome or avoid them. It is evident that we must learn more about bacterial enzyme systems, particularly how to stimulate the development of new ones.

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Designs for Retirement

We have created an economy which forces people to give up their usual activities while many years of life yet remain. We have still to apply ingeniously and imaginatively the knowledge we now have to the creation of a way of life in which the retired continue to share in the social process.

The increasing commitment of American society to an extended period of retirement was recognized by the University of Michigan in planning its 12th Annual Conference on Aging, held June 22-24, 1959, in Ann Arbor.

With "Designs for Retirement" as its theme, the conference brought together more than 1,000 figures in gerontological thought to explore the nature and implications of individual and social factors in aging. The scope of these pertinent facets of retirement living was reflected by the five major segments in which the conference was divided: financing, health, housing, preparation, and uses.

An assessment of past experience and current research gave new insights into systems of cultural values, use of free time, services, varieties of suitable housing and living arrangements, and programs of individual preparation to give vitality, meaning, and social significance to the retirement years.

Five briefs of papers delivered at the conference follow.

Work, Income, and Housing

brief

Improvements in medical procedures, new medications, and upgrading of nutrition here and throughout the world are enabling more men and women to live beyond their 65th birthday. Since the turn of the century, the number of people aged 65 and over has increased more than 3½ times, from 3 million to more than 14 million, while the total population barely doubled. By 1980, it is estimated the number of aged in the United States will have risen to some 25 million in an anticipated population of roughly 260 million.

Only a fraction of the aged population in the United States is institutionalized. The last complete census in 1950 showed that only 3.1 percent of the persons 65 years of age or over

Based on a paper presented by E. Everett Ashley 3d, director, Statistical Reports and Development Branch, Housing and Home Finance Agency.

were living in institutions such as hospitals, nursing homes, homes for the aged, and the like. Other aged persons, while not institutionalized, are incapacitated by chronic illness. A survey conducted in August 1957 disclosed that 15 percent of the noninstitutionalized population aged 65 and over were unable physically and mentally to carry on major activities such as gainful employment, housework, or out-of-doors recreation. Another 42 percent, while still able to carry on major activities, were handicapped to some extent by chronic illness. (Recent figures published by the Public Health Service estimate 21 million persons over 55 years of age with chronic illness, of whom 9.5 million are limited in their activity and 2.7 million are unable to work.)

Employment and Pensions

The long-range trend in the proportion of workers among older persons has been downward. Between 1890 and 1940, the proportion of men 65 years of age and over in the labor force dropped from 68 percent to 42 percent, and by the end of 1958 it had dropped to only 35 percent. In contrast, the rates for older women in the labor force in the United States continue to rise slowly over the years. The ratio of women 65 years of age and older was less than 8 percent in 1890; it is now slightly more than 10 percent. Among men, an important reason for leaving the labor force is disability; among women, keeping house is the most frequent reason given for not working at a paying job. The increase in pension programs of one sort or another, coupled with mandatory retirement in many industries, is of growing importance.

Nine-tenths of the Nation's 65.4 million paid workers were covered by the basic national system of old-age, survivors, and disability insurance in June 1958. This broad coverage includes virtually all the gainfully employed. Major groups not covered by the basic program are certain government employees who have separate retirement systems and self-employed physicians, as well as some who work part-time or with low earnings.

Also in June 1958, 8.8 million, or three-fifths of all aged persons, were drawing benefits under

the OASDI program. The total number of the aged eligible for benefits (including those not receiving benefits because they had not yet retired) was 10.5 million, or four-fifths of all men and three-fifths of all women aged 65 or over.

The amount paid to workers is determined by past earnings, under a formula designed to give a higher proportion to low-paid workers than to those with high earnings. A recent change in the law established the maximum payment beginning in 1959 as \$116 per month for a worker alone and \$174 for a married couple in which the wife qualifies as a dependent.

In addition, the Federal Government makes grants to States for financial assistance to needy individuals and families. And other Federal-State public assistance programs aid the aged. For example, nearly one-half of the blind are 65 years of age or over; the majority of the disabled are in late middle life, with approximately one-third at least 60 years of age; and about one-tenth of the dependent children aided by such programs are living with a grandparent.

Nearly 21½ million people 65 years of age and over are now receiving old-age assistance, and about one-fourth of them are receiving assistance to supplement their insurance benefits.

Beyond the cited programs, at the close of 1957 about 23,000 American firms had pension plans covering approximately 16,800,000 persons, practically all of whom were also covered by the OASDI program. About \$1,100 million in benefits was paid to some 1,320,000 annuitants in 1957 under these private systems.

Housing

Adequate housing and living arrangements are important to people of all ages, but the living environment is of primary importance to the elderly, who are especially vulnerable to disturbing surroundings.

In individual dwellings as well as in group accommodations, healthful housing for older people depends largely upon design features which minimize accident hazards, permit easy care of the household, and supply proper size and space arrangements. It is recommended that a dwelling unit for the elderly contain the following:

1. Complete dwelling facilities on one floor, including a bathroom, with that floor reached by few, if any, steps.

2. No thresholds or other tripping hazards.

3. Nonslip surfaces in hallways, bathrooms, and kitchens, to further minimize the danger of falling.

4. Handrails by all steps and inclines.

5. Adequate handgrips, capable of supporting a heavy person, by all bathtubs and toilets.

6. Adequate illumination of all steps and other potentially hazardous areas.

7. Fully automatic central heat, where climatic conditions require it.

Other features which might be present are:

1. At least one bedroom and elimination of any plan which includes use of the living room for sleeping.

2. Doors wide enough to permit moving about the dwelling in a wheelchair.

3. Windows easily operated and cleaned.

4. A bathroom large enough and so designed as to permit its use by a wheelchair patient.

Desirable features, although not always practical to obtain, would be:

1. Communication by any feasible system from the bathroom and bedroom either to an adjacent dwelling unit or any point where aid is available most of the time.

2. A floor plan and window design which permits sunlight to penetrate into the dwelling unit, especially during the winter months.

In addition to satisfactory design, a dwelling for an older person should be located:

1. Near adequate public transportation.

2. Adjacent to everyday shopping facilities.

3. Convenient to adequate medical and hospital facilities.

4. Free from major traffic hazards.

5. Away from sources of excessive noise, malodorous fumes, or smog.

6. Close to recreational facilities.

7. In a neighborhood free from serious urban blight or slums.

8. In familiar surroundings near the occupants' usual circle of friends.

Except for a small fraction of the elderly population which is institutionalized, most of the aged people in the United States either maintain their own living quarters or live with relatives or friends. The U.S. Bureau of the

Census in its census of housing in 1950 found that close to one-third of the people 65 years of age or older lived with relatives. Some of them still owned their own homes and had sons or daughters living with them, presumably to provide companionship and care. In a large proportion of cases, however, parents had moved in with their children and no longer had a home of their own.

The proportion of homeownership, some 68 percent, among this age group exceeds that of any other in the population. And in 1950, some 75 percent of the homes owned and occupied by persons 65 years of age and older were in satisfactory structural condition.

Federal Aid to Housing

In recent years far more emphasis is being placed on housing for older people in the United States. Since 1956 it has been possible for friends or relatives or even a corporation to make the down payment on a house being purchased by a person 60 years of age or older and have the mortgage insured by the Federal Housing Administration. In addition, when an elderly person, either because of age, physical condition, or financial position, is unable to qualify as an acceptable mortgage risk, it is permissible for a third party to become a co-signer of the mortgage. Loans up to \$22,500 may be insured and repaid in as long as 30 years. It is also now easier for older persons to trade their existing houses for units better suited to their retirement years, since many of them already are homeowners.

Amendments to the National Housing Act also make it easier for nonprofit organizations to finance the construction or rehabilitation of rental accommodations for the aging. Such an organization as sponsor of a rental housing project of eight units or more specifically designed for the use and occupancy of older people is eligible for FHA mortgage insurance at a maximum of \$9,000 per dwelling unit, this amount being increased to \$9,400 per unit for elevator-type structures if a nonprofit project. The mortgage may be as much as 100 percent of replacement cost, while a profit-motivated project may have a mortgage of as much as 90 percent. If the project involves

rehabilitation of an existing structure rather than new construction, the ratios apply to value rather than replacement cost. Projects can be in the form of elevator-type structures, row houses, or even separate dwelling units if they are grouped in a contiguous project and can be for both families and single persons. In most instances, there is a mortgage limitation of \$12,500,000 for any one project. To assist in the provision of nursing care facilities for the elderly, FHA is now also authorized to insure mortgages on proprietary nursing homes if they meet certain specified requirements of standards and services.

But there are still those who simply cannot afford to pay the current rental cost. For this group, it is now possible for single elderly persons of low income to be admitted to low-rent public housing projects. Authority is also given to the Public Housing Administration to assist local housing authorities in building new housing or remodeling existing low-rent public housing projects to provide accommodations specifically designed for older families.

In addition to Federal aid in housing the elderly, several of our States give assistance, notably New York and Massachusetts. And there is widespread interest from coast to coast in FHA nonprofit rental housing. As of June 30, 1959, there were 48 such active projects in 21 States, with mortgages running close to \$50 million and containing more than 5,600 units, sponsored in the main by church groups.

The Federally aided low-rent housing has also been gaining headway. As of June 30, 1959, there were either built or to be built 12,434 units specifically set aside for the elderly. In addition to these special units for the elderly, the Public Housing Administration estimates that better than 80,000 persons aged 65 or older are living in regular low-rent housing developments.

Benefits to the aged from the low-rent housing program are not, of course, limited to new units planned specifically for them. Fifty thousand families now residing in public housing projects are headed by persons 65 years of age or older, and many younger families include an aged person.

Experience has demonstrated that a satisfactory environment for older people requires more than comfortable living quarters. The need for interpersonal relationships does not abate with age, but rather, need for the security offered by close ties and companionship may actually increase as the individual grows older and is less capable of managing his own environment. There is considerable evidence to suggest that the homogeneity of the social structure in a housing development is even more important than good design and good location.

Viewing our present aged population and considering its prospective increase in the next quarter century, housing accommodations for the aging must be built at an accelerated rate to meet the need in the years ahead.

Retirement Research Strategy

brief There seems to be a general sparsity of interchange between social scientists and practitioners in today's research climate for studies of the aged in general and evaluation of preparation for retirement programs in particular. In spite of acknowledgment given the importance of reciprocity between research and application, we find a dearth of it in practice.

Major improvements would be to increase the number and quality of studies in this field both by social scientists and by practitioners. The burgeoning field of medical sociology is an example. Through recognition by some medical personnel that sociologists could contribute by investigating sociocultural factors associated with illness or with a variety of problems associated with medicine as a profession, opportunities have gradually opened for sociologists. These opportunities for research and teaching positions and for research grants and fellowships have stimulated the sociological profession to take a far more active interest in medical sociology. I see no major reason why a similar burgeoning cannot take place in the

Based on a paper presented by Bernard S. Phillips, assistant professor of sociology, University of Illinois.

field of aging. It is no less amenable to social science approaches than medicine. The amount of research by social scientists in this area is pitifully small, and we cannot expect rapid advances unless there are rapid changes.

To increase the amount and quality of research by practitioners dealing with the aged, the first step would be to record the situation, the decision or action taken, and the detailed results, so that others may have the benefit of this experience. However, this is only the first step. Very often there are opportunities where research consultants would prove helpful in establishing the investigative formula for giving results more general applicability, in setting up a research design which converts a projected change of procedure into a controlled experiment, or aiding with analysis. Whether simple or sophisticated, such research by practitioners could help fill gaps and lead to cumulative knowledge.

Retirement effects on the individual are often quite complex and sometimes contrary to accepted ideas. For example, the Cornell study of occupational retirement found no great increase in dejection, hopelessness, and dissatisfaction with life among workers who retired. Other factors obviously pertained. Those with more favorable preretirement attitudes were found to be better adjusted and less dejected. None of these relationships, however, were close.

Several criticisms may be made of what may be called the old-age-problems approach to investigating the effects of retirement. A high proportion of retirees face financial restraints, inadequate housing, and social isolation, but there is no uniform degree of impact. While we may generalize about the mass, the object of inquiry is the welfare of the individual, with all his contradictions, quirks, and idiosyncracies.

In the problems approach, there is also a tendency toward descriptive, as distinct from explanatory, research. We are ultimately interested in those factors which play a part in influencing psychological reactions to retirement. By focusing on factors common to many individuals, we may ignore the peculiar matrix of conditions in each particular case which produces a given reaction to retirement. An explanatory approach would, on the other hand, lead to investigating relationships between a

White House Conference

Aging, a tangle of physical, social, and economic strands, has summoned National, State, and local specialists to a series of sessions in preparation for a White House Conference in January 1961. Committee chairmen and members of the National Advisory Committee to the conference met with Secretary of Health, Education, and Welfare Arthur S. Flemming on July 30, 1959.

State workshops and institutes are developing individual responsibilities for the conference program. The National Leadership Training Institute, convened immediately following the University of Michigan's 12th Annual Conference on Aging, was such a session.

To date, 37 of the 50 States and the District of Columbia have applied for Federal grants from \$5,000 to \$15,000 to help finance preconference activities.

multiplicity of factors, such as preretirement attitude, and some criterion of the degree to which retirement adjustment is "successful."

If we are to evaluate preretirement programs, we must have some measure of effectiveness. What results do we expect in the individual if preparation for retirement is extremely successful? If it is not successful?

An individual's mental welfare may be viewed either negatively or positively. An example of a negative definition is adjustment, defined as the degree to which unfulfilled needs are absent. A person with extremely few needs or desires may lead a vegetative type of existence and yet be classified as well adjusted if these needs are satisfied. The limitations of such a measure should be kept in mind.

Positive mental health may be exemplified by such a measure as autonomy, defined as the degree to which the individual has strongly felt needs and is aware of them. This type of measurement avoids a definition in terms of absence of something and specifies that presence of something, namely strongly felt needs and awareness of them, is necessary to achieve a high rank on a scale of mental health. The well-adjusted yet vegetative personality would, consequently, rank low.

These are only examples of evaluative criteria for preretirement programs. Whatever concepts are chosen, it is vital that some measure or measures be used as criteria for the degree of success. It is all too easy to assume that a program is an effective one simply because, on the basis of intuitive judgment, its audience seems interested or enthusiastic. For a variety of reasons, such judgments are usually quite useless.

If serious evaluative efforts are undertaken, we should be prepared to stand by the results. It may very well be that most current preretirement programs do not result in any significant improvement in the lot of the retiree. It may be, for example, that the major determining factor in postretirement success has to do with personality traits developed throughout life, and that even an excellent program can add little more to the picture. Or it may be that the American value system, with its heavy emphasis on continuing occupational success, is such that it would be difficult for the retiree, no matter how well prepared, to counteract this climate of opinion.

Once criteria for evaluation are developed and careful measurements tested, the next step is to identify those factors associated with high scores. Preliminary research has shown, for example, that "felt age," or how old a person feels, is associated with adjustment among individuals 60 years of age and over. Those who feel middle aged rather than old seem better adjusted, and such an attitude successfully counteracts the shock of retirement, death of spouse, and chronological aging.

Further study has shown that individuals who feel old are more negative in a variety of attitudes. They believe that the aged should dress conservatively, that the friends of old people should be old, that interest in sex is undignified for an older person, that the aged should expect aches and pains, and that doctors treat the young better than the old, and thereby accept a low cultural evaluation of themselves through these negative attitudes. There is less tendency for this low evaluation by the individual who considers himself only middle aged.

What are some of the practical implications of such research? Examples can be found in

golden age clubs, residential areas, and hobbies for the aged, and the possible impact of advice on these matters given during preretirement programs. It is entirely conceivable that membership in golden age clubs hastens the identification of oneself as old, a factor which seems to be related to maladjustment. The establishment of segregated communities for the aged may provide the very best housing, medical, and recreational facilities, yet isolation from functions normal to a mixed community may serve to encourage older age identifications and thus prove deleterious. The value of hobbies depends on the degree they represent a genuine investment of the individual's interests.

More and better research is needed. But it will not come to pass unless something is done to change the present climate of research vis-à-vis research opportunities and closer relationship between practitioners and social scientists.

Economic Facts

brief The elderly, if they do not work productively or gainfully, are often as individuals pinched for funds, and in the mass they are an economic burden to others unless they are assured of income from past savings or social benefits. We know relatively little about the factors underlying withdrawal of older persons from the labor force. There is some evidence, however, that such withdrawal is the result more of external factors than of a voluntary desire to retire. There is much evidence that many older men would prefer to work rather than to retire and that involuntary factors, particularly compulsory retirement, account for their exodus from the labor force.

The expected period of retirement for a young man of 20 more than doubled between 1900 and 1955. In 1900, a man of 20 had a life expectancy of 42.2 years, a working life expectancy of 39.4 years, and an expected period of retirement of 2.8 years. By 1955, his life expectancy had increased to 49.5 years, his

Based on a paper presented by Philip M. Hauser, professor and chairman of the department of sociology, University of Chicago.

working life expectancy to 43.0 years, and his outlook for retirement had increased to 6.5 years. In the year 2000, the length of the retirement period may well triple the 1900 figure.

The magnitude of the change which has taken place is shown in comparing source of income for persons 65 years of age and older even between 1950 and 1956:

<i>Source of income</i>	<i>Percent</i>	
	<i>1950</i>	<i>1956</i>
Total.....	100.0	100.0
Employment.....	30.8	27.7
Social insurance and related programs..	28.5	57.7
Public assistance.....	22.5	17.4
No money income or other sources.....	25.2	10.0

SOURCE: U.S. Bureau of the Census: Statistical Abstract of the United States, 1958, p. 269.

Government and private pension and retirement plans and personal savings undoubtedly are related to the fact that the older population is receiving a steadier and more dependable flow of income than ever previously achieved in the history of the industrial United States. This is not to say, however, that we have achieved a state, either in coverage or in the amount of benefits, which meets adequately the financial needs of older persons.

Rapid social change creates problems of adjustment for persons of all ages, but it poses much more difficult problems for older persons. Persons now 65 years of age and over have lived through profound technological and cultural changes. Technological innovations have frequently resulted in the obsolescence of the occupational skills providing prestige, psychological adjustment, and economic security for older persons.

Social adjustment may necessitate reconsideration of present pension plans, retirement provisions, discriminatory hiring and firing practices, and the design of flexible conditions of work, including hours and types of services for the older worker. Social adjustment may also require the revamping of government programs which, in the main, are based on traditions of "poor relief" and the meeting of dire need created by the depression during the thirties. Government maintenance of income flow for the aged is not based on a comprehensive study of the economic problems of old age but rather represents a combination of patchwork provi-

sions improvised under the pressure of severe depression and political unrest.

As our knowledge of old age and retirement and its problems has increased, we have become more aware of the need to reexamine much of what exists in the form of present policy and practice. We have become aware, among other things, of the need to reexamine the meaning of retirement itself, for certainly there is no clear-cut boundary line between the "retired" and nonretired older worker. And perhaps there should not be! We have used up to this point the lazy man's administrative device of adopting uniform, compulsory practices to deal with the extremely variable situation with which the older person is confronted as he nears the end of his work career.

Just as a variable cannot be explained by a constant in the realm of physics, so it is unlikely that variable needs can be met by a uniform program in the realm of gerontological social engineering. Compulsory retirement at an arbitrarily fixed age without regard for the productive capacity, personal desires, and psychological and social needs of the person is undoubtedly a major factor contributing to the difficulties of both personal and social adjustments to old age. Furthermore, it is becoming increasingly clear that this practice represents a huge and tragic waste of manpower and national production at all times, and especially in times of national emergency.

It would be patently absurd to abolish retirement systems or even compulsory retirement systems. But compulsory retirement could depend on criteria other than chronological age. This determination, from a personal, social, and economic standpoint, could be more sensibly based on the capacity and willingness of the person to be productive. The measurement of continued capacity to produce at older ages is admittedly difficult. It is a subject for intensive and expanded research if equitable and efficient determinations are to be made. But the problem is not insoluble.

Providing adequate employment for older workers who desire it will require significant changes in a number of attitudes and practices of management in hiring and firing. That discriminatory practices against the older worker exist is clear. That justification for such prac-

tices exists, in terms of productivity of the older worker, his skill, or his dependability, is not so clear. Such evidence as is available suggests, on the contrary, that the older worker who is not afflicted with definite physical impairments or chronic disorders which handicap him more than holds his own with younger workers in many types of occupations and industry. Many of the discriminatory hiring and firing practices appear to stem from superstitions rather than from economic and factual considerations. Here again there is a great need for effective research to provide a factual basis for evaluation of the productivity and the economic contribution of the older worker and to point up the specific occupations and industries in which he can be utilized most effectively.

In general there can be little doubt that we have the capacity to deal with the economic problems of old age. Our productivity and our expanding economy can unquestionably meet the demands represented by the requirements of older persons as well as those of other claimant groups. The question is not one of determining whether we can afford the maintenance of an older population, a large proportion of which can, in fact, maintain itself if given the opportunity to do so. Our problem is rather one of determining most effectively how to utilize our human as well as other resources to assure not only subsistence but the good life for all. We have in a major way succeeded in adding years to life; we are still only scratching the surface of the task of adding life to years.

Health Care



The problem of providing health care to the aged has been stated succinctly in the opening chapter of a recent report of the U.S. Department of Health, Education, and Welfare: "How can higher than average medical needs be financed out of lower than average financial resources?"

Based on a paper presented by Basil C. MacLean, M.D., M.P.H., president of the Blue Cross Association.

Unfortunately the question lends itself more easily to simple definition than to simple solution. Were the question directed to some uncomplicated primitive societies, it could be answered directly by a few basically human manifestations of compassion, love, generosity, and respect for age, an answer made even simpler by the few, if any, medical resources available. There are, of course, opposite human reactions by other primitive groups who discard at the side of the trail those of their number who can maintain no longer the productivity of health and youth.

For the problem is ultimately a moral one, regardless of the level of society in which it is posed. The answer to it is, for many, a valid yardstick of the worth of any society, simple or complicated. How do we treat and assess our older citizens? Do we discard them at the side of the trail or do we make the golden years a clear recognition of service performed and rewards deserved? And do the terms of that recognition afford dignity, independence, and respect for its recipients?

This is not the only great social question of our time that, when everything else is stripped away, stands revealed as a simple morality. It is useful, from time to time, to see these questions so, in order to maintain our bearings and to remind ourselves of our ultimate goal. Yet we must return again, however reluctantly, to that "everything else" which we so casually stripped away, because this is the meat of the matter in our immensely complicated world.

"Everything else" is the entire framework of our society, its traditions, laws, and customs as they have evolved and elaborated themselves. "Everything else" is usually a matter of money. Personal compassion may be expressed by a word or a gesture, but social compassion obligates people to subdue their differing definitions of the emotion and find a way to allocate the necessary funds for the compromise. It is easy enough to find a moral position on providing health care to our aged, but it is not so easy to find workable ways of making funds available and distributing these funds through the channels of communication, exchange, vested interests, and intensely differing opinions that offer themselves for use.

It is the "everything else" which we must solve.

Some say there is little, if anything, to solve. It is quite true that almost any elderly person in the United States who needs health care will get it. It is true that, if he cannot pay for it, he will get it free, either by the generosity of the one who provides the care or by the organized generosity of charity. However, it is also true that many elderly people who need care that is beyond their means delay getting it or do not seek it at all because they do not want it under humiliating circumstances.

There is no way of avoiding the fact that the aged simply cannot afford to pay the cost of health care from current income at the time of illness. Only about 40 percent have some kind of prepayment against hospital costs, most of it expensive and limited in benefits. About four-fifths of the aged attempt to assume the burden of payment out of their own resources for other than hospital care. The story written by these crisp figures is a story of self-denial, anxiety, and an undermining of life savings meant for basic necessities. There is no way to measure the amount of helpless dependency behind these figures, the destructive pressures upon relatives and family resources. Figures such as these should be matters of great concern to any society that prides itself upon the independence of its people.

For we should be concerned, not just with the fact that health care is available to anyone who needs it, but equally with the conditions under which it is dispensed. Any design for retirement, in these days, must be loomed upon a framework of dignity and independence. A major reliance upon charity is dignified neither for the recipient nor for the giver. We should be concerned also with the fact that free care, or partly free care, which places the burden of expense and noblesse oblige upon the provider of service, is a drain upon the entire community. It pinches off sources of revenue which the community's health facilities must have in order to expand, to grow, and to stand ready to meet the health care needs of all. Our voluntary hospitals, for example, cannot tolerate much longer the economic drag on expansion and proper financing that is put upon

them by the load of free and part-pay care. Under the light of this important consideration, the whole question becomes no longer one of sentiment, morality, or compassion, nor even solely one of health care for the aged, but rather a question of adequate financing for the entire community's health plant and the establishment of fertile conditions for growth in health facilities that is in pace with the march of science. More graphically, to be concerned that elderly people be covered against the cost of hospital care under terms of decency and respect is at the same time to be concerned that the hospitals be not denied necessary equipment and expansion or adequately paid personnel because the books are in the red.

The answer must be composed of several elements if it is to work, if it is to meet the needs of the aged and of the provider of hospital services.

It must cover the cost of the entire package of hospital services. Only in this way can our aged be assured of access without barrier to the services they require, not simply because they are covered for all these services but also because the hospital, adequately financed and recompensed for their care, is able to furnish the services. Service benefits make the elderly patient a full-pay patient, a status that yields a harvest of therapy to his own self-esteem, his medical and psychological needs, and the economic health of the hospital. Indemnities, on the other hand, maintain him in a state of dependency as a part-pay patient and maintain the hospital as a "part-collect" agency writing its records in red ink, a condition not good for either. For the needs of both patient and hospital, it is often debatable whether or not part-pay status is any real improvement over no pay.

The service benefit approach is especially suited to the needs of the aged, whose admissions are characterized by prolonged and frequent use of the broadest possible scope of hospital services and facilities. It makes possible an approach to the question of prudent cost that works not within the realm of financial deterrents to use, but rather as a more rationalized and economic use of an even broader range of hospital services covered under prepayment. Services and practices

appropriate to geriatric care can be developed which take the prepayment dollar a longer way. Expanded hospital outpatient services, home nursing, and nursing homes are but a few of these.

It is essential, as it is with other elements of retirement security, that the cost of such coverage be distributed, at least in part, over the working years. In short, the cost must be rationalized through the proved method of prepayment.

The pooling of risk and the distribution of cost must be done on some basis if cost of care for the aged is to be within reach. The public is moving toward a major policy decision on how to strengthen prepayment financing for aged citizens. The task can be done through the medium of proved and experienced voluntary prepayment plans if augmented by governmental resources as may be needed.

The opening question, "How can higher than average medical needs be financed out of lower than average financial resources," can only be answered by, "They cannot." They can be financed only through a pooling of the community's financial resources, a fact which is becoming increasingly apparent. The methods and media through which these resources will be organized, allocated, and dispensed are not yet fully chosen and committed, but are still evolving.

Rehabilitation



A high proportion of all illness is caused by chronic diseases, and a significant majority of all hospital beds in the United States are occupied by patients suffering from strokes, arthritis, neurological disorders such as Parkinson's disease, cerebral palsy, paraplegia, and the like, civilian accidents, industrial accidents, and other chronic disabling conditions.

Based on a paper presented by Max Karl Newman, M.D., director, Detroit Institute of Physical Medicine and Rehabilitation, and director of the department of physical medicine and rehabilitation of Carmel Hall, Detroit Memorial Hospital, Sinai Hospital, and the Jewish Home for the Aged, Detroit, Mich.

To combat and control chronic diseases, and the illness and disability that result from them, the full force of modern medicine and almost the entire range of medical and specialized services, equipment, and physical facilities are needed. Until more knowledge is gained of primary prevention of chronic diseases in children, adults, and the aged, restorative or rehabilitative medicine is needed. If it were to be provided adequately in the State of Michigan alone, however, 23 rehabilitation centers distributed throughout the State, costing from \$1 to \$3 million per institution, would be required, exclusive of the salaries of personnel numbering into the hundreds.

In this obvious impossibility, the rehabilitative service can and should be located in a general hospital as is now being done at Detroit Memorial Hospital and Sinai Hospital in the city of Detroit. Advantages of location in a general hospital are ready availability of all types of medical specialists and consultants, access to both inpatient and outpatient care, lack of duplication of certain types of facilities, possible earlier referral of the patient, better dissemination of knowledge concerning rehabilitation, wider uses of the rehabilitation principle in patient care, and total medical and surgical service.

To the uninitiated, a restorative and rehabilitative medicine program uses physical and occupational therapy under the direction of a physiatrist (the specialist in the field of physical medicine and rehabilitation) on the patient with chronic disability, such as stroke, arthritis, or a surgically repaired bone not being properly used by the patient. Psychological and social services are then added and, as the patient progresses, a State agency gives vocational counseling, testing, and job training, or ways and means of functioning to the maximum capacity despite the disability are supplied.

Many of the disabled added each year to our population could benefit by restorative or rehabilitative medicine and they can be treated early in the general hospital. If this is not done, we shall be overwhelmed in the not too distant future with a backlog of infirm and disabled old and young persons, deprived of their earlier potentialities for rehabilitation. Our medical resources will have failed these people

only by inactivity. And our economy and community standard of living will be seriously threatened by responsibility for their care.

We are past the time when we can debate whether we can afford to supply maximum rehabilitative services within our general hospital program. Rather, our question is how much longer can we afford not to. To the individual patient, it means rehabilitative services immediately following an accident or disabling illness and early restoration to the most active life consistent with his residual capacities without a long interval which permits the physi-

cal disability to progress or the patient to develop resistance toward rehabilitative efforts. To the community, restoration of every disabled person to the most useful existence possible, whether returned to a job or simply trained for maximum self-care, means a corresponding decrease in the responsibilities of the productive members of the population. To the general hospital, rehabilitative service means a more dynamic medical program, spreading through all departments and creating more interest in the diminution of long-term patient disability and an earlier release of hospital beds.

Health Manpower Outlook

The ratio of physicians to population in the United States, which has ranged between 131 and 135 per 100,000 persons for 20 years, will drop to 126 per 100,000 by 1975 unless the rate of graduating students increases substantially, according to the latest in a series of health manpower reports issued by the Public Health Service. The number of dentists per 100,000 persons in the population is expected to decline even more sharply.

Entitled "Health Manpower Source Book, Section 9: Physicians, Dentists, Nurses," the report reveals trends in the education, location, and specialization of these professional personnel.

In the academic year 1958-59, the 85 medical schools in the United States graduated 6,895 physicians. To maintain the present physician-population ratio, our medical schools would need to graduate about 10,360 students in 1975, nearly 3,000 above the 7,410 graduates currently predicted for that year.

The 47 dental schools in the United States graduated 3,083 dentists in the academic year 1957-58. Despite the addition of eight new dental schools since World War II and large increases in the number of graduates, the ratio of dentists to population remains below pre-World War II levels. To regain the current dentist-population ratio, about 2,700 more dental graduates above the number currently predicted will be needed in 1975. This calls for a 75 percent increase in the number of den-

tal students who, according to present estimates, will be graduated during that year.

According to the report, the ratio of dentists was 62 per 100,000 people in 1940 and 57 in 1958, and is expected to decline to about 50 per 100,000 in 1975. There should, however, be an increase in the ratio of professional nurses, from 268 per 100,000 population in 1958 to 284 per 100,000 in 1970.

The nurse-population ratio has increased almost fivefold in the United States since 1910. In the academic year 1957-58, the 1,145 schools of nursing in the United States enrolled about 113,000 students and graduated 30,410 nurses. Admissions to these schools are expected to increase in the next decade, and annual graduations of up to 37,000 students are predicted by 1965.

The current combined ratio of doctors of medicine and osteopathy to population is about 140 per 100,000 persons. This is expected to decline to 133 per 100,000 by 1975. To maintain the current ratio, about 11,000 graduates a year from the Nation's schools of medicine and osteopathy will be needed in 1975, an increase of slightly more than 3,000 above the number expected for that year on the basis of present estimates.

The report contains State and regional as well as national data. It was prepared by the Service's Division of Public Health Methods, in cooperation with the Divisions of Dental Resources and Nursing Resources.

Diet Care and Services for Patients With Cardiovascular Disease

BETH HEAP

AS INVESTIGATORS seek the causative and preventive factors in heart disease, the public is demanding information on how to apply findings in heart research to patterns of daily living. Articles, books, and radio and television programs have supplied information, and health agencies have held open meetings, particularly on the subject of obesity and cardiovascular disease, in an effort to meet this demand. Recently the American Heart Association and the National Heart Institute presented a summary entitled "A Decade of Progress Against Cardiovascular Disease" (1).

Although diet as therapy seems to be increasing in importance, especially in the prevention and control of atherosclerosis, it is only one interrelated factor in the medical care regimen.

Status of Diet Therapy

Briefly, current diet therapy in cardiovascular disease emphasizes (a) calorie restriction to achieve and maintain correct weight, (b) sodium restriction to control the edema which often accompanies congestive heart failure and to lower blood pressure in some cases of hypertension, and (c) selection and restriction of fats as a possible factor in the treatment and prevention of atherosclerosis.

Obesity, or even relatively mild overweight,

is considered a hazard to patients with heart disease, and weight reduction is generally the physician's first order for overweight cardiac patients. Physicians vary in their methods for treating obesity, but they agree as to its danger to health, especially in heart disease. Generally, they also agree that patients should continue on an adequate diet, and when specific modifications are necessary, they should be made only on the physician's recommendations.

Sodium restriction is the established diet therapy in the treatment and control of the edema accompanying congestive heart failure. Physicians prescribe diets of designated levels of sodium according to the individual patient's needs. In some cases of hypertension, sodium restriction helps to lower blood pressure.

Sodium-restricted diets are also prescribed for the prevention of edema when treatment includes the use of such medications as adrenal steroids which have sodium-retentive properties and cause excessive fluid accumulation in the tissues.

At present there is no established dietary treatment for atherosclerosis. Current studies indicate several important facts that relate dietary fat to the level of blood cholesterol. Increasing evidence points to the importance of the ratio of saturated to polyunsaturated fats in the diet in altering serum cholesterol. Metabolism studies indicate that polyunsaturated fats in the diet usually reduce the serum cholesterol and increase the cholesterol and cholic acid in the feces. Serum cholesterol concentration is a good indication of the total lipid concentration, but its true relation to coronary artery disease is still undetermined.

Miss Heap is chief nutrition consultant, Heart Disease Control Branch, Division of Special Health Services, Public Health Service. The article is based on a paper given at the Annual Health Conference of the Pennsylvania Department of Health, held at University Park, August 18, 1959.

However, diet is only one of the factors in atherosclerosis. Some others being studied singly and in combinations are sex, age, race, physical exercise, heredity, and stress. Until we learn more, it is impossible to pinpoint the one determining factor—dietary, physical, or environmental.

The current, widespread practice is to prescribe a modified diet on the theory that it will be beneficial to the patient with a certain heart disease.

Diet therapy in heart disease, except for a few treatments of established value, is constantly changing, partly because of new findings. It is important to establish the possible benefits of each discovery to patients with cardiovascular disease.

Because of the need for information and diet guides on fat selective and fat restrictive therapy, the American Heart Association and the American Medical Association are preparing such material for the use of physicians. Its purpose is to explain the current situation and what can be expected of this type of diet therapy with the knowledge that these prescribed diets will do no harm and that they may do some good.

However, the patient's adherence to the diet regimen is the final test. Diet therapy, for the most part, is a do-it-yourself project. It is the patient himself, or the person caring for him, who must understand and follow through on a diet.

One of the biggest blocks to a successful dietary regimen is the patient's lack of sufficient instructions when the diet is prescribed. If the patient is to derive the expected benefits, he must know what changes are required and how to make them accurately for each meal as long as he is on the prescribed diet.

When the physician prescribes a diet modification, it is his responsibility to initiate the patient's diet education and, as necessary, refer him to a diet counselor (nurse, dietitian, or nutritionist) for supplementary assistance. Few physicians can take the time to do more than explain the principles of the diet and give the patient standard diet references. But rarely can adequate instructions be given or learned in one quick lesson.

Counseling Services

The majority of patients on prescribed diets lack the adequate counseling services which they should have. I exclude patients who are referred periodically during treatment by their physicians to dietitians or nurses for dietary guidance, patients attending clinics where dietary counseling is an integrated patient-care service, and hospitalized and institutionalized patients. I am concerned about the patients who, for the most part, have had only one instruction session, generally at the time the diet was prescribed. These patients are living at home and working.

Regardless of age or education, the average person does not have sufficient knowledge to fulfill accurately the requirements of most diet prescriptions. He is deluged by new and strange duties and rules. Perhaps he must learn the names and meanings of such unfamiliar nutrients as fatty acids, sodium, polyunsaturated fats, and cholesterol, and how to measure them in units, exchanges, grams, or milligrams. He needs explanations and guidance as each new need arises. When these services are provided adequately, he can follow a diet correctly.

However, even with close guidance by physician and diet counselor, it is not always easy for the patient to master the many details of his diet. To persist in meticulous daily application of his new dietary regulations demands both interest and ability.

Patients are often told to "cut down," "cut out," or "go easy" on salt, starches, or fats. Many persons disregard such advice and continue on their way, unworried. Others are convinced, however, that the prescription is essential to their health. They seek any source of help. They spend time and money and often become confused and unduly worried because the physician said, "Watch your calories."

This picture is not exaggerated. Every day numerous inquiries about prescribed diets find their way to pharmacists, government agencies, librarians, Congressmen, and even to charlatans and special food stores. Requests for help range from questions about sodium restriction to the meaning of hydrogenated and unsatu-

rated fat. These requests make it clear that patients are interested in learning what their diets mean and how to carry them out.

Printed as well as oral instructions should always be a part of any prescribed diet. Standard diet references are a tool designed to help the patient help himself. Three sodium-restricted diet booklets (2) are the most recent patient education references. However, any diet pamphlet is standard only while on the shelf. Little attention or space can be devoted in standard guides to individual problems such as limited education, inadequate income, or lack of interest. And it is in solving these difficulties that individual counseling is of the greatest benefit.

A patient is justified in expecting adequate dietary instructions, just as he expects the services of a pharmacist for his drugs, of a nurse for his injections, and of a physical therapist for his exercises. Yet today only a small percentage of patients have the opportunity to obtain dietary counseling. The question is how can more of these services be developed.

There are several ways, but few of them have been explored, and few have been successful. Perhaps the most practical would be a cooperative community service designed to serve all patients on their physicians' referral. Such a service would assure physicians that their patients would receive sound dietary instruction supported by recommended diet guides or manuals. The patient would be better prepared to shoulder his diet therapy responsibilities, and the community would be one step higher on the ladder of improved health services.

Although there is a dearth of counseling services, recognition is growing that adequate diet education is essential for more effective diet therapy and for the development of sound nutrition practices in the general population.

Among the many diet pamphlets particularly helpful to persons who are not on prescribed diets are three basic guides. "Food for Fitness: A Daily Food Guide" is designed for all ages (3). "The Food You Eat and Heart Disease" summarizes current knowledge about diet and cardiovascular disease (4). "Food Guide for Older Folks" includes pointers on planning, buying, and preparation of food and recom-

mendations for adjustment of calories as energy and maintenance needs decrease (5).

Future Activities

For the future, I visualize nutrition education activities which will encompass the presumably healthy adult population as well as those under medical treatment. On the premise that the earlier one starts to achieve and maintain maximum nutritional health, the better the results, the development of two new nutrition education activities seems advisable.

The first is a sound nutrition course for all high school students. Its primary aim would be to teach students the relation of adequate diet to good nutritional health. Most young people, particularly boys, leave high school and soon accept family responsibilities with the scantiest understanding of this fundamental subject.

Second, I envision a community dietary counseling service available to anyone who requests nutrition information. This same service would also be available on referral by a physician to any patient on a prescribed diet. Such a service would be one more means of helping to prevent as well as to correct nutritional disorders.

A community dietary counseling service will achieve effectiveness only when it is initiated, directed, and used consistently by members of local medical societies in cooperation with other community health groups.

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Hospitals and Nursing Homes in the United States, 1959

LESLIE MORGAN ABBE, B.S.

This report brings up to 1959 the general review of hospital beds in the United States published in Public Health Reports, May 1955, pp. 484-491. It includes for the first time inventories and programs of skilled nursing homes under the Federal grant-in-aid (Hill-Burton) program.

IN THE YEARS since World War II good health has become popular. People generally know that the modern skills in health care have greatly improved, and that the resources for treatment and prevention are an important part of their personal needs. This awareness has led to broad public support for the major outlays needed to build hospitals, clinics, nursing homes, and rehabilitation centers. Gains in the postwar period have been impressive for some of our health resources, while losses have occurred in others. The new forms of therapy, together with changing characteristics of our population as a whole, pose new needs hardly imagined a generation ago.

This report reviews national trends and net gains in health facilities in the United States in the last 10 years and it provides a look ahead. It is based on the series of comprehensive plans for hospital and medical facilities developed by the States under title VI of the Public Health Service Act. Hospital data are now available on a comparable reporting basis for 12 years, from 1948 through 1959. Data for skilled nursing homes are available only since 1957, but such record is considered to be reasonably com-

prehensive. Inventories in these plans reflect designed capacities, rather than present bed complements. The State plans include long-range programs for additional bed needs. Another, more limited, approach to the future is also described in this paper, with specific goals for health facilities in the next decade, as developed recently by the Public Health Service.

The State plans provide data on all facilities open to civilians, with the exception of Federal hospitals of the Veterans Administration and the Public Health Service. They report all hospitals according to the four principal categories of service provided: general, mental, chronic, and tuberculosis. They also include skilled nursing homes and a variety of facilities confined entirely or principally to outpatient care, such as public health centers, diagnostic and treatment centers (both as outpatient departments of hospitals and as independent clinics), and rehabilitation centers. This report deals only with inpatient facilities.

At the beginning of January 1959, according to the State plans, the Nation had 1,322,000 hospital beds and 245,000 beds in nursing homes which provide skilled nursing care. Not all these beds, however, are acceptable for long-range planning purposes. On the basis of fire and health hazards, 168,000 hospital beds and 112,000 nursing home beds are classified as nonacceptable.

Data for each State and Territory are shown in tables 1 and 2. For easy comparison, the States are grouped by the broad socioeconomic regions of the United States. Federal beds for civilians are not included in these figures. They comprise 126,000 beds in hospitals of the

Mr. Abbe is assistant chief of the Program Evaluation and Reports Branch, Division of Hospital and Medical Facilities, Public Health Service.

Table 1. Existing civilian hospital beds ¹ in the United States and Territories, by service category, January 1, 1959

State and socioeconomic region	General		Mental		Chronic		Tuberculosis	
	Acceptable	Nonacceptable	Acceptable	Nonacceptable	Acceptable	Nonacceptable	Acceptable	Nonacceptable
United States ²	587, 318	65, 764	445, 009	88, 578	44, 461	6, 622	76, 685	7, 760
New England	32, 312	7, 339	34, 435	5, 579	5, 401	3, 018	3, 986	1, 100
Connecticut	8, 321	261	8, 905	145	1, 441	0	727	0
Maine	2, 439	1, 306	2, 768	25	65	106	196	254
Massachusetts	15, 364	5, 165	16, 408	4, 147	2, 727	2, 912	2, 405	703
New Hampshire	2, 056	176	2, 180	120	0	0	87	0
Rhode Island	2, 883	12	3, 258	0	1, 168	0	571	0
Vermont	1, 249	419	916	1, 142	0	0	0	143
Middle East	138, 299	16, 868	126, 944	36, 709	15, 750	873	15, 751	3, 720
Delaware	1, 676	50	1, 000	645	750	142	223	0
District of Columbia	4, 286	264	5, 979	0	136	0	870	0
Maryland	8, 364	141	8, 653	144	2, 541	0	1, 644	0
New Jersey	16, 705	1, 197	19, 181	1, 046	345	0	2, 752	110
New York	59, 985	8, 887	61, 267	22, 169	6, 778	77	6, 270	2, 534
Pennsylvania	40, 259	5, 136	26, 736	12, 705	4, 445	654	2, 982	1, 076
West Virginia	7, 024	1, 193	4, 128	0	755	0	1, 010	0
Southeast	108, 466	10, 631	75, 861	18, 206	5, 482	189	17, 146	303
Alabama	9, 525	393	3, 861	3, 815	160	0	1, 147	22
Arkansas	5, 614	847	2, 760	1, 726	192	0	1, 653	0
Florida	12, 522	1, 643	11, 984	264	753	15	2, 169	0
Georgia	12, 062	1, 264	11, 528	0	505	30	2, 088	0
Kentucky	9, 192	533	7, 232	115	449	0	1, 355	0
Louisiana	11, 048	770	7, 894	94	441	0	1, 642	0
Mississippi	5, 975	1, 461	4, 047	1, 894	140	25	650	0
North Carolina	14, 578	476	12, 482	0	547	47	2, 246	0
South Carolina	5, 745	1, 383	2, 079	2, 502	71	0	877	140
Tennessee	10, 497	1, 515	6, 558	3, 111	1, 632	72	1, 574	141
Virginia	11, 708	346	5, 436	4, 685	592	0	1, 745	0
Southwest	44, 523	4, 225	24, 877	966	1, 942	84	6, 485	209
Arizona	3, 716	529	1, 529	0	211	0	722	115
New Mexico	2, 600	355	1, 279	0	321	6	330	74
Oklahoma	9, 436	348	8, 137	0	591	0	947	0
Texas	28, 771	2, 993	13, 932	966	819	78	4, 486	20
Central	159, 937	15, 316	102, 166	20, 246	10, 012	2, 006	18, 823	1, 340
Illinois	33, 590	4, 051	21, 363	7, 055	2, 944	205	4, 621	0
Indiana	11, 521	2, 558	6, 402	2, 856	520	150	1, 055	467
Iowa	10, 694	1, 052	3, 979	1, 639	1, 150	75	476	14
Michigan	24, 344	3, 878	14, 397	6, 596	676	0	4, 472	121
Minnesota	14, 132	861	9, 807	365	597	0	1, 495	0
Missouri	17, 303	1, 267	10, 758	120	1, 480	775	1, 682	0
Ohio	32, 158	1, 297	23, 532	224	1, 531	792	3, 633	618
Wisconsin	16, 195	352	11, 928	1, 391	1, 114	9	1, 389	120
Northwest	34, 248	5, 796	20, 699	5, 469	1, 347	0	2, 452	353
Colorado	5, 657	1, 670	3, 527	2, 903	52	0	806	154
Idaho	1, 374	1, 124	1, 036	20	37	0	50	35
Kansas	8, 597	785	3, 221	2, 498	240	0	522	20
Montana	3, 344	243	1, 906	0	196	0	285	0
Nebraska	6, 116	405	5, 256	48	303	0	221	0
North Dakota	2, 904	295	1, 829	0	76	0	300	0
South Dakota	2, 710	497	1, 669	0	42	0	118	144
Utah	2, 184	589	1, 483	0	386	0	100	0
Wyoming	1, 362	188	772	0	15	0	50	0
Far West	61, 782	5, 198	55, 922	1, 363	3, 788	20	8, 226	718
Alaska	641	355	18	0	0	0	475	299
California	47, 016	2, 070	44, 757	296	3, 129	0	5, 774	354
Nevada	785	158	580	0	20	0	36	23
Oregon	5, 474	1, 360	4, 243	70	349	20	500	42
Washington	7, 866	1, 255	6, 324	997	290	0	1, 441	0
Territories	7, 751	391	4, 105	40	739	432	3, 816	17
Guam	161	0	0	0	0	0	160	0
Hawaii	1, 758	391	928	40	353	396	949	0
Puerto Rico	5, 698	0	3, 151	0	386	36	2, 677	17
Virgin Islands	134	0	26	0	0	0	30	0

¹ Excluding Federal facilities.

² Includes Territories.

SOURCE: State plans, approved under title VI of the Public Health Service Act.

Veterans Administration, 6,500 beds in hospitals operated by the Public Health Service for merchant seamen and others, and about 1,200 beds in Indian hospitals.

Postwar Construction and Net Gains

During World War II and for most of the depression decade preceding the war, hospital construction was curtailed, piling up a serious backlog of need. After the war when money, men, and materials became available for peacetime development, a great upturn in hospital construction took place. This was stimulated by Federal assistance provided by the Hospital Survey and Construction Act of 1946 (now referred to, with its amendments, as title VI of

the Public Health Service Act). In this period, too, a large increase occurred in construction of new Federal hospitals for the Veterans Administration. As shown in figure 1, total hospital construction reached a peak of more than \$5 per capita in 1951, dropping to a little more than one-half this level in 1956. Thereafter, another marked upturn took place, largely as a result of increased Federal support. A further rise is predictable through 1960 on the basis of Federal funds now appropriated. Figure 1 is based on constant prices, thus discounting the marked increase in construction costs, amounting to 44 percent, which has occurred since 1947-49. In current dollars, the 1958 volume of \$1,011 million exceeded the previous alltime peak of \$947 million in 1951.

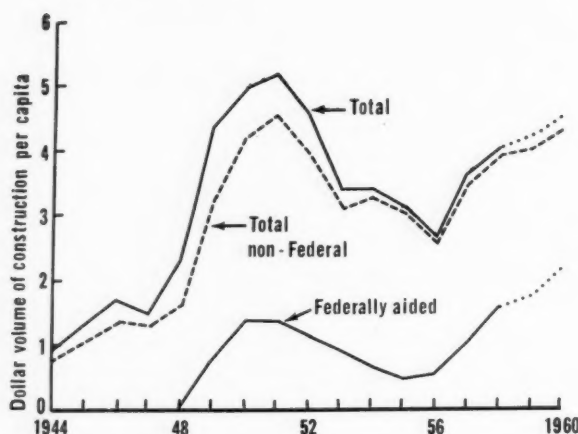
Table 2. Existing beds in skilled nursing homes in the United States and Territories, January 1, 1959

State and socioeconomic region	Skilled nursing home beds		State and socioeconomic region	Skilled nursing home beds	
	Acceptable	Nonacceptable		Acceptable	Nonacceptable
United States ¹	133, 016	112, 815	Central	34, 048	56, 720
New England	7, 347	20, 574	Illinois	3, 881	19, 631
Connecticut	3, 943	2, 544	Indiana	342	8, 262
Maine	0	1, 211	Iowa	2, 082	14, 791
Massachusetts	409	14, 544	Michigan	4, 112	4, 366
New Hampshire	581	1, 450	Minnesota	7, 013	2, 462
Rhode Island	2, 195	0	Missouri	3, 957	0
Vermont	219	825	Ohio	8, 770	5, 839
Middle East	30, 037	10, 850	Wisconsin	3, 891	1, 369
Delaware	121	0	Northwest	5, 722	5, 263
District of Columbia	1, 026	22	Colorado	989	2, 953
Maryland	1, 297	2, 445	Idaho	698	469
New Jersey	8, 068	0	Kansas	162	233
New York	12, 222	4, 316	Montana	794	199
Pennsylvania	5, 528	4, 058	Nebraska	443	638
West Virginia	1, 775	9	North Dakota	523	231
Southeast	19, 099	5, 235	South Dakota	431	249
Alabama	515	381	Utah	1, 553	0
Arkansas	1, 216	1, 314	Wyoming	129	291
Florida	3, 629	1, 309	Far West	28, 170	10, 918
Georgia	2, 311	511	Alaska	84	15
Kentucky	1, 396	168	California	17, 689	3, 797
Louisiana	3, 393	0	Nevada	296	48
Mississippi	580	347	Oregon	2, 339	3, 048
North Carolina	315	63	Washington	7, 762	4, 010
South Carolina	493	576	Territories	225	237
Tennessee	1, 233	566	Guam	0	0
Virginia	4, 018	0	Hawaii	138	200
Southwest	8, 368	3, 018	Puerto Rico	87	37
Arizona	425	70	Virgin Islands	0	0
New Mexico	541	47			
Oklahoma	1, 997	421			
Texas	5, 405	2, 480			

¹ Includes Territories.

SOURCE: State plans, approved under title VI of the Public Health Service Act.

Figure 1. Value of all hospital construction in the United States and Territories, at constant prices, 1944-60



Trends in the Nation's total civilian resources for inpatient care appear in table 3, together with rates of availability per 1,000 population and of additional need, as recorded in the State plans. An expanding population and mounting obsolescence have offset new construction to a marked degree, so that from 1948 to 1959 the increase of 306,000 beds for all hospital purposes has resulted in a gain of less than 0.5 bed per 1,000 population for acceptable facilities. There are now 20,000 more nonacceptable beds in hospitals than were reported initially in 1948. Also, nearly one-half of the nursing home beds failed to meet current standards.

An elaboration of table 3 is presented in table 4 to show annual trends by type of service provided. In rates per 1,000 population, this record displays substantial progress for general hospitals, a small gain and subsequent decline in mental hospital beds, a rise and decline in tuberculosis beds, and a slow growth in chronic hospital beds. Every category has increased in the actual number of acceptable beds.

The distribution by State of the net gain in total beds available in the decade 1949-59 shows substantial variation (fig. 2). States with rapid population growth increased their total beds much more rapidly than States of little or no growth. This relation applies both to percentage increase and to the quantitative increase expressed as gain in beds per 1,000 of the population living in the State during the base year 1949. The net gain in beds per 1,000 pop-

ulation is not related to State income levels; the general trend for all States shows a gain of about 2 beds per 1,000 of the base year population at all income levels. However, percentage gains were much higher in low-income States, where the initial level of availability was low.

Local circumstances have produced occasional wide departures from the trend. Still, the broad pattern of relationship between net gains, income levels, and rate of population growth provides a new dimension of understanding and prediction. It is encouraging to find that net gains are related to population growth and that they are largely commensurate with it. Study has shown that the gains in the low-income States are predominantly the result of the Federal assistance (Hill-Burton) construction program. It must be noted that this analysis of net gains in the 1949-59 decade relates to total existing beds for all categories of hospitals. Throughout this period between 8 percent and 9 percent of these beds have been deemed obsolete and needing replacement.

Additional Needs

Basic standards of need developed in the State plans have undergone gradual changes since 1948, as shown by the data on acceptable beds and additional beds needed in table 3. From 1948 to 1959 the total need for hospital beds reported decreased from 12.8 beds per 1,000 population to 11.8. This decrease is two-thirds of the net decrease in additional need reported.

Historical data on need by single categories appear in table 4. The need for additional general hospital beds has been reduced nearly one-half, and the need for more tuberculosis beds, on a nationwide basis, reduced drastically (from 0.61 to 0.11 bed per 1,000 population) because of diminishing incidence of new cases. The States have continued to use a presumptive standard of need for mental hospitals of 5 beds per 1,000 population. According to this measure, construction of mental hospitals has not kept pace with population growth, with the result that there is a net increase in additional need of 0.17 bed per 1,000 population.

There is prospect of a long-continued backlog of needed construction, to judge by the historical trend of slow overall gain in beds per 1,000

Table 3. Trends in total civilian beds for inpatient care,¹ United States and Territories, 1948-59

Year (January 1)	Total beds needed ²	Existing beds					Additional beds needed	
		Total	Acceptable			Nonac- ceptable	Number	Rate per 1,000 pop- ulation
			Number	Rate per 1,000 pop- ulation	Percent of total need			
	Total beds for inpatient care ³							
1956 ⁴ -----	2, 012, 179	1, 407, 375	1, 180, 135	7. 29	58. 6	227, 240	1, 039, 628	6. 42
1957 -----	2, 399, 060	1, 505, 034	1, 219, 885	7. 43	50. 8	285, 149	1, 184, 245	7. 21
1958 -----	2, 444, 726	1, 521, 267	1, 238, 188	7. 36	50. 6	283, 079	1, 211, 141	7. 20
1959 -----	2, 412, 802	1, 568, 028	1, 286, 489	7. 52	53. 3	281, 539	1, 119, 165	6. 54
	Total hospital beds							
1948 -----	1, 776, 401	1, 016, 712	867, 960	6. 28	48. 9	148, 752	908, 441	6. 57
1949 -----	1, 776, 673	1, 025, 179	879, 872	6. 30	49. 5	145, 307	896, 801	6. 42
1950 -----	1, 850, 052	1, 118, 535	952, 196	6. 49	51. 5	166, 339	897, 856	6. 12
1951 -----	1, 883, 487	1, 185, 480	1, 009, 918	6. 78	53. 6	175, 562	873, 569	5. 87
1952 -----	1, 899, 806	1, 193, 836	1, 017, 823	6. 71	53. 6	176, 013	881, 983	5. 81
1953 -----	1, 899, 279	1, 218, 781	1, 057, 427	6. 90	55. 7	161, 354	848, 567	5. 54
1954 -----	1, 887, 372	1, 242, 087	1, 083, 056	7. 00	57. 4	159, 031	812, 765	5. 25
1955 -----	1, 926, 600	1, 275, 072	1, 098, 815	6. 93	57. 0	176, 257	838, 745	5. 29
1956 -----	1, 960, 410	1, 279, 050	1, 117, 933	6. 91	57. 0	161, 117	850, 061	5. 25
1957 -----	1, 985, 354	1, 287, 051	1, 106, 991	6. 74	55. 8	180, 060	883, 433	5. 38
1958 -----	2, 009, 040	1, 299, 832	1, 125, 169	6. 69	56. 0	174, 663	888, 474	5. 28
1959 -----	2, 027, 750	1, 322, 197	1, 153, 473	6. 74	56. 9	168, 724	867, 129	5. 07
	Nursing home beds (skilled care) ³							
1956 ⁴ -----	251, 769	128, 325	62, 202	0. 60	24. 7	66, 123	189, 567	1. 84
1957 -----	413, 706	217, 983	112, 894	. 69	27. 3	105, 089	300, 812	1. 83
1958 -----	435, 686	221, 435	113, 019	. 67	25. 9	108, 416	322, 667	1. 92
1959 -----	385, 052	245, 831	133, 016	. 78	34. 5	112, 815	252, 036	1. 47

¹ Excluding Federal facilities.

² As limited by title VI of the Public Health Service Act and State programing thereunder. For some types of service, some States now have beds in excess of these measures of need.

³ No data reported for nursing homes for 1948-55.

⁴ Preliminary report for nursing homes, from 34 States.

SOURCE: State plans, approved under title VI of the Public Health Service Act.

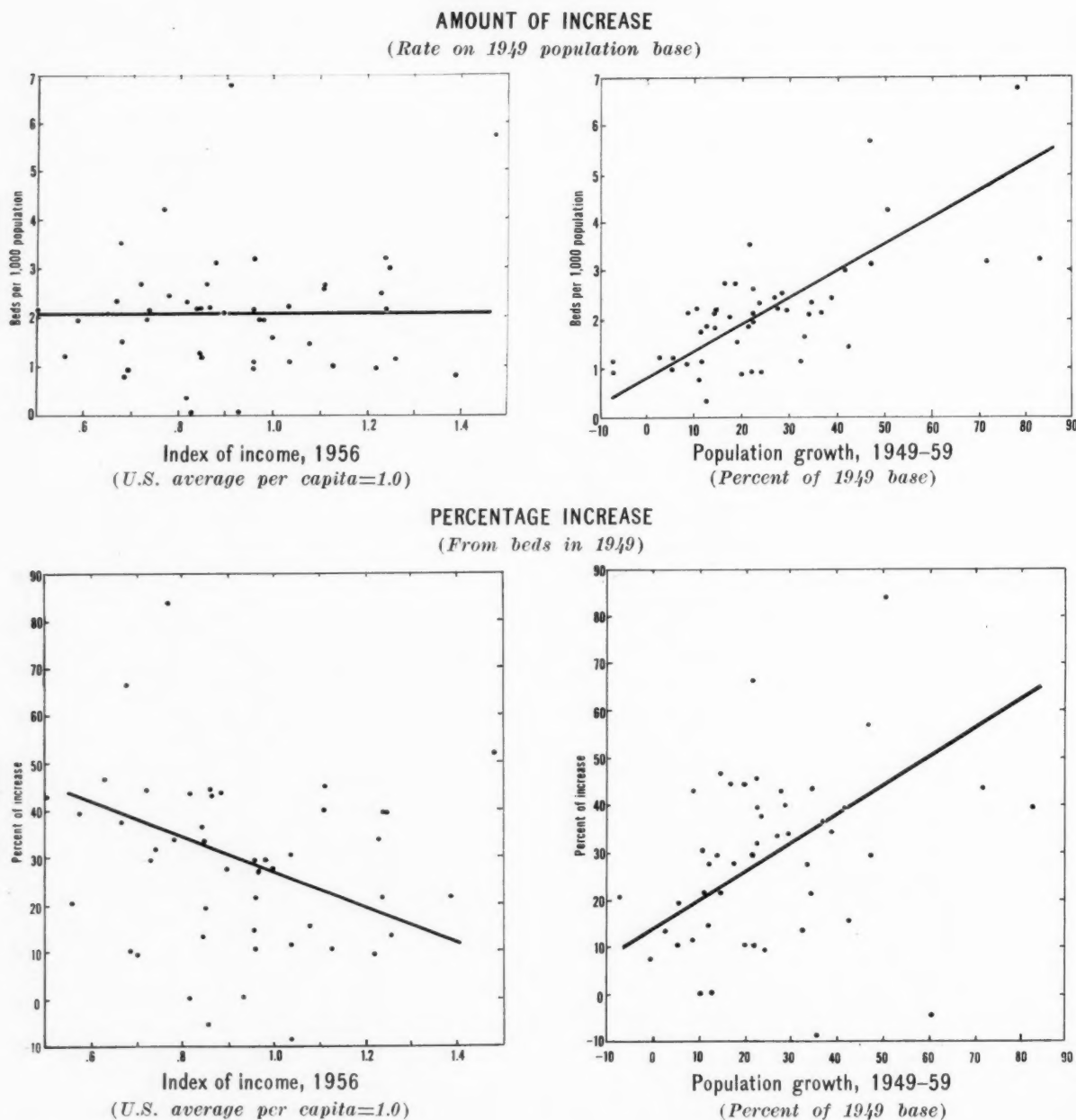
population. In this context it is useful to analyze specific levels of actual programing in each State. The additional construction definitely planned at identified sites is found, upon study, to be strongly related to the level of average income in a State, as well as to the level of acceptable beds now available.

Figure 3 shows the trend of beds now available and those programed in relation to income level for three main classes of care: short-term care in general hospitals, long-term care in chronic hospitals and nursing homes, and care in mental hospitals. The charts reflect a sum-

mary of trends found in scatter diagrams prepared from data for all the States and must not be taken as an exact pattern for all States. They show a marked tendency at all incomes for States to program at a constant level above that of the acceptable beds available, rather than to a uniform standard of need. This is particularly true for mental hospitals.

It appears that the short-term plan of most States reflects official judgment on feasible advances for the near future. This may be entirely realistic, as against arbitrary standards of long-range need. The Public Health Service

Figure 2. Increase in total civilian hospital beds in relation to State income level and population growth, 1949-59



has recently withdrawn all uniform standards of adequacy from its regulations for carrying out title VI of the Public Health Service Act, except for a minimum planning level of 2.5 beds per 1,000 population for each service area of general hospitals. Changes may therefore be expected as each State comes to identify its own formal targets of need. This new flexibility may mark a second major phase of positive planning for the Nation's health facilities, after

the early pioneering stage when statewide planning was itself an innovation and uniform standards were a valuable guide.

A Look Ahead

Prospects for the future in regard to the Nation's health plant point to a high construction expenditure during 1959 and 1960. However, because of increased construction costs (about

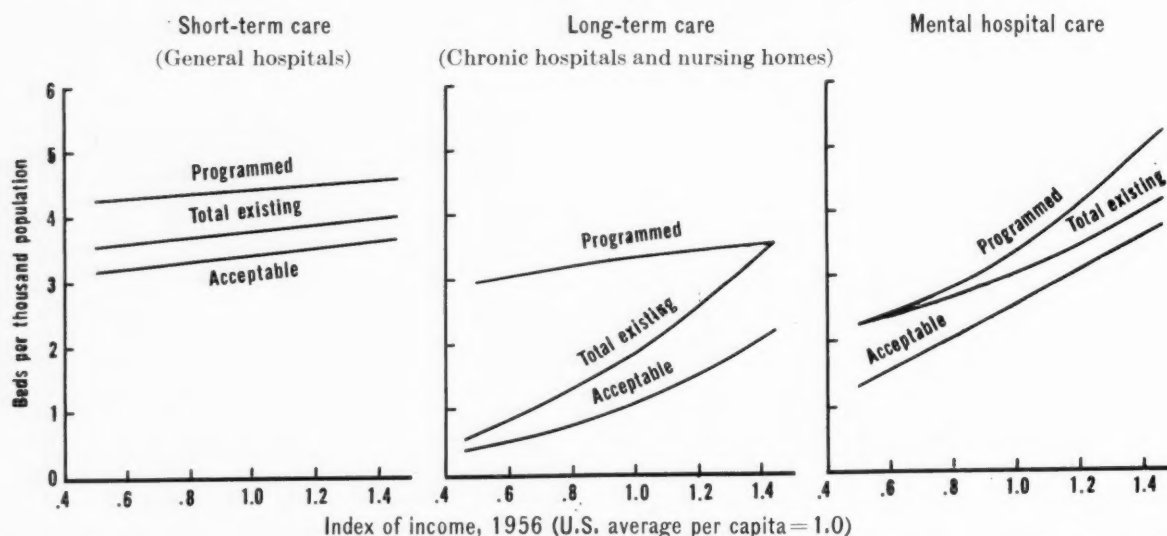
Table 4. Trends in civilian hospital beds,¹ by type of service, United States and Territories, 1948-59

Year (January 1)	Total beds needed ²	Existing beds					Additional beds needed	
		Total	Acceptable			Non- acceptable	Number	Rate per 1,000 pop- ulation
			Number	Rate per 1,000 pop- ulation	Percent of total need			
General hospital beds								
1948	652, 974	469, 398	388, 144	2. 81	59. 4	81, 254	264, 830	1. 92
1949	652, 611	474, 532	397, 168	2. 84	60. 9	77, 364	255, 443	1. 83
1950	682, 601	513, 814	437, 786	2. 99	64. 1	76, 028	244, 815	1. 67
1951	700, 952	548, 798	469, 192	3. 15	66. 9	79, 606	231, 760	1. 56
1952	708, 574	554, 084	474, 334	3. 13	66. 9	79, 750	234, 240	1. 54
1953	714, 469	572, 493	495, 185	3. 23	69. 3	77, 308	219, 222	1. 43
1954	704, 400	589, 565	515, 934	3. 34	73. 2	73, 631	188, 420	1. 22
1955	720, 001	601, 241	526, 458	3. 32	73. 1	74, 783	193, 543	1. 22
1956	722, 112	614, 020	541, 363	3. 35	75. 0	72, 657	180, 749	1. 12
1957	726, 821	620, 922	547, 473	3. 33	75. 3	73, 449	179, 926	1. 10
1958	745, 016	632, 674	559, 818	3. 33	75. 1	72, 856	185, 776	1. 10
1959	761, 610	653, 082	587, 318	3. 43	77. 1	65, 764	174, 292	1. 02
Mental hospital beds								
1948	690, 381	427, 201	380, 343	2. 75	55. 1	46, 858	310, 038	2. 24
1949	692, 150	428, 931	381, 627	2. 73	55. 1	47, 304	310, 523	2. 22
1950	725, 203	462, 859	399, 138	2. 72	55. 0	63, 721	326, 065	2. 22
1951	744, 323	483, 310	415, 530	2. 79	55. 8	67, 780	328, 793	2. 21
1952	755, 097	482, 733	412, 932	2. 72	54. 7	69, 801	342, 165	2. 25
1953	766, 463	490, 598	431, 007	2. 81	56. 2	59, 591	336, 676	2. 20
1954	773, 428	500, 568	437, 659	2. 83	56. 6	62, 909	336, 989	2. 18
1955	793, 125	513, 278	441, 440	2. 78	55. 7	71, 838	352, 349	2. 22
1956	808, 265	520, 010	449, 706	2. 78	55. 6	70, 304	359, 223	2. 22
1957	821, 412	525, 455	435, 453	2. 65	53. 0	90, 002	387, 587	2. 36
1958	840, 782	528, 406	441, 691	2. 63	52. 5	86, 715	400, 719	2. 38
1959	855, 649	533, 587	445, 009	2. 60	52. 0	88, 578	412, 574	2. 41
Tuberculosis hospital beds								
1948	155, 987	84, 158	71, 151	0. 51	45. 6	13, 007	84, 836	0. 61
1949	155, 101	85, 466	72, 560	. 52	46. 8	12, 906	82, 541	. 59
1950	148, 936	94, 024	81, 511	. 56	54. 7	12, 513	67, 425	. 46
1951	140, 391	96, 955	85, 351	. 57	60. 8	11, 604	55, 040	. 37
1952	133, 899	99, 147	87, 550	. 58	65. 4	11, 597	46, 349	. 31
1953	112, 075	100, 204	86, 698	. 57	77. 4	13, 506	30, 934	. 20
1954	100, 467	101, 425	86, 035	. 56	85. 6	15, 390	21, 707	. 14
1955	96, 507	100, 234	85, 901	. 54	89. 0	14, 333	20, 902	. 13
1956	114, 536	96, 268	84, 923	. 52	74. 1	11, 345	36, 533	. 23
1957	119, 653	91, 301	81, 491	. 50	68. 1	9, 810	41, 026	. 25
1958	114, 449	87, 967	79, 523	. 47	69. 5	8, 444	37, 323	. 22
1959	104, 555	84, 445	76, 685	. 45	73. 3	7, 760	18, 788	. 11
Chronic hospital beds								
1948	277, 059	35, 955	28, 322	0. 20	10. 2	7, 633	248, 737	1. 80
1949	276, 811	36, 250	28, 517	. 20	10. 3	7, 733	248, 294	1. 78
1950	293, 312	47, 838	33, 761	. 23	11. 5	14, 077	259, 551	1. 77
1951	297, 821	56, 417	39, 845	. 27	13. 4	16, 572	257, 976	1. 73
1952	302, 236	57, 872	43, 007	. 28	14. 2	14, 865	259, 229	1. 71
1953	306, 272	55, 486	44, 537	. 29	14. 5	10, 949	261, 735	1. 71
1954	309, 077	50, 529	43, 428	. 28	14. 1	7, 101	265, 649	1. 72
1955	316, 967	60, 319	45, 016	. 28	14. 2	15, 303	271, 951	1. 71
1956	315, 497	48, 752	41, 941	. 26	13. 3	6, 811	273, 556	1. 69
1957	317, 468	49, 373	42, 574	. 26	13. 7	6, 799	274, 894	1. 67
1958	308, 793	50, 785	44, 137	. 26	14. 3	6, 648	264, 656	1. 57
1959	305, 936	51, 083	44, 461	. 26	14. 5	6, 622	261, 475	1. 53

¹ Excluding Federal facilities. ² See table 3, footnote 2.

SOURCE: State plans, approved under title VI of the Public Health Service Act.

Figure 3. Trend of civilian hospital beds available and programed, 1959, in relation to State income level, 1956



44 percent since 1948) much larger sums are required than in the past for comparable results. In addition, scientific and technological changes have created new services and new means of therapy requiring new kinds of facilities, while changes in the age of the population and shifts in population to large cities and their suburbs are creating new needs and maldistribution of facilities, requiring costly relocations. Other factors to be considered include the following:

1. In urban centers the hospital plants are relatively old, needing much renovation and modernization aside from actual replacement.

2. There is a new understanding of the importance of community resources for mental health care in clinics and psychiatric treatment units of the larger community hospitals.

3. The great cost of building and operating hospitals today forces attention to planning for coordination of all resources for health in the community. In particular, the long-term care of the elderly in family settings, clinics, nursing homes, and hospitals requires more attention to provide skilled services in facilities which are interrelated for common purposes.

In the light of these circumstances, which suggest substantial shifts in emphasis, the Public Health Service has recently developed national goals for health facilities during the next decade (1). These goals have guidance status only, but they reflect a concrete program (a)

with genuine net improvement on a scale appropriate to current purposes, (b) feasible to achieve within a time span which recognizes the possible impact of new discoveries in medical knowledge and therapy, and (c) reasonably possible to finance. The goals are as follows:

- Provision of sufficient new beds annually to continue the present level of 7.5 beds per 1,000 population for the annual population increase, which now exceeds 3 million persons.

- Provision of an additional 0.2 beds per 1,000 population annually in order to bring the level of all inpatient beds to 9.5 beds per 1,000 by 1970 (more than double the net advance of 0.80 beds per 1,000 population achieved in the past decade). The total gain by 1970 would be apportioned as follows:

- 0.5 beds per 1,000 for general hospital care.

- 0.5 beds per 1,000 for mental hospital care.

- 1.0 beds per 1,000 for long-term care facilities.

- Replacement of old hospital plant which becomes obsolete annually (obsolete plant being defined as that 50 years old).

- Renovation and modernization over a 10-year period (estimated at \$1 billion).

- Increase in outpatient care facilities to equal the net gain of the last decade for public health centers and diagnostic and treatment centers and a reasonable increase in rehabilitation centers.

Table 5. Health facility program goals, 1960-70

Purpose and type	Average annual program		
	Added capacity		Estimated cost (millions)
	Rate per 1,000 pop.	Number	
All facilities-----			\$1,600
<i>Inpatient care</i>			
All inpatient care ----		81,500 beds	1,490
Population increase at 3 million per year.	7.5	22,500 beds	405
Additional facilities for 185 million population (average).	.2	37,000 beds	590
Replacement (facilities 50 years old).		22,000 beds	395
Modernization-----			100
<i>Outpatient care</i>			
Facilities for diagnosis, treatment, and rehabilitation.		230 units	70
<i>Research</i>			
At 0.5 percent of operating cost.			40

• Increase in research on hospital planning, operation, and use.

These goals would require construction to provide annually about 81,500 inpatient beds and 230 outpatient facilities, at a total annual cost of \$1,600 million, as shown in table 5. This annual expenditure is about \$600 million more than the amount expended in 1958 for health facility construction. It would constitute a substantial acceleration, with important shifts in emphasis to meet changing conditions. It cannot be achieved without broad understanding and support for its underlying purposes as a national investment for health as a basic resource.

Summary

At the beginning of 1959 the Nation had 1,322,000 non-Federal hospital beds and 245,000

beds in nursing homes which provide skilled nursing care, besides about 134,000 beds for civilians in Federal hospitals.

The rate of new construction is now at an alltime peak, in current dollars, but construction costs have increased by 44 percent within the last decade.

The total gain of more than 300,000 hospital beds since 1948 appears substantial, but when offset by the increase in population it amounts to only 0.5 beds per 1,000 population for acceptable facilities.

States with rapid population growth have increased the total number of hospital beds more rapidly than States of little or no growth.

Percentage gains were greatest in low-income States, where the initial level of availability was low.

Basic standards of total need for hospital beds have decreased somewhat with operating experience in State planning, but the relatively low rates of net gain in beds for hospitals and nursing homes during the past decade in relation to population to be served, indicates a long-continued backlog of needed construction.

State planning tends toward programing for specific construction at a uniform level above present level of availability, rather than upon a uniform standard of need. This may be realistic in the light of economic differentials.

For the future, changes in emphasis to meet shifting needs and new scientific and technological discoveries are expected.

A 10-year program goal has been developed by the Public Health Service to raise the total level of inpatient beds from 7.5 beds per 1,000 population to 9.5 beds per 1,000 by 1970, with increased emphasis on mental hospitals, long-term facilities for the aged, and a modernization program. This would require an estimated expenditure of \$1,600 million annually, which is about 60 percent above the present level of construction.

REFERENCE

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Genetics and Public Health

N. C. MYRIANTHOPOULOS, Ph.D.

The epidemiological-genetic approach is ideally suited to investigations concerning the estimation of gene frequencies and mutation rates, the selective advantage of certain genotypes, the detection of heterozygous carriers, the metabolic etiology of genetic disease, and the practice of genetic counseling. Progress in any of these areas has numerous public health applications.

THE INCREASING application of human genetics in the fields of epidemiology and preventive medicine has brought about a necessary collaboration of these disciplines on a close and equal basis. Efforts to understand, control, prevent, or eradicate disease are greatly aided by the advances in genetics during the past 25 years and the growing appreciation of the human host as an important factor in the etiology of disease. The ensuing reevaluation and realinement of concepts regarding etiology are well illustrated by Shimkin (1), who, in a recent review on the etiology of cancer, writes:

"There are few, if any, simple or single causes in biology. There are, instead, complex situations and environments in which the probability of certain events is increased. The probability of the neoplastic event following exposure of an organism to a carcinogenic stimulus is modified by a large series of factors. In regard to the stimulus, among the more evident influences are those of dose, route of exposure, physical state of the material, and length and schedule of exposure. In regard to the host, the probability of the neoplastic reaction is influenced by the genetic background, age, sex, nutritional status, and intercurrent

infections. The longer the period between initial exposure and the end point of the reaction, the more opportunities occur for the introduction of additional modifying factors."

It is not too farfetched to claim that all diseases have a genetic component. Heredity, of course, does not operate in a vacuum. The environment influences its expression to a greater or lesser degree, so that it is well nigh impossible to differentiate between "purely genetic" and "purely environmental" disease. In this context the human condition appears as a continuum formed by the interaction of genetic and environmental influences. At one end of the continuum are those diseases in which the genetic factors are most powerful and the influence of the environment negligible; these are illustrated by Huntington's chorea or Tay-Sachs disease. At the other end are those diseases in which environmental factors play the chief role while genetic elements are least influential; these are exemplified by infectious diseases whose occurrence depends on the presence of the infectious agent. Between these two extremes, the genetic and environmental influences operate with varying degrees of interaction in the causation of disease.

When diseases are observed to occur in familial aggregations, it is desirable to clarify the relative roles of heredity and common exposure to some environmental stress. Neel and Schull (2) advance four criteria by which the influence of genetic factors in the etiology of disease can be detected: (a) the occurrence of the disease in definite numerical proportions among individuals related by descent; (b) failure to "spread" to nonrelated individuals; (c) onset at a characteristic age without a known precipitating cause; and (d) greater concordance in identical twins than in fraternal twins. These

Dr. Myrianthopoulos is a geneticist in the Epidemiology Branch, National Institute of Neurological Diseases and Blindness, Public Health Service.

criteria must be applied with extreme caution and critical judgment, for the pitfalls of error are many. For years, for example, because syphilitic women tended to have syphilitic babies, the disease was considered hereditary, although it is now realized that the infant is infected during gestation. Even in a disease such as tuberculosis, although predisposition may be genetically determined, the aggregation of many cases in a family is generally conceded to be a result of common exposure.

In the study of the natural history of a disease, epidemiology is, in a sense, the intelligence service of medicine. It provides information on the extent and distribution of the disease by analyzing its prevalence and incidence, mortality, age and sex distribution, geographic distribution, periodic occurrence, and association with other diseases and environmental factors. Attempts to control, prevent, and eradicate disease depend largely on such epidemiological studies to guide the attack on the causative factors or to strengthen the host and his environment, or both.

Genetics has become an adjunct to both of these fundamental phases of public health: epidemiology and preventive medicine.

Genetics and Epidemiology

The circumstances which have brought genetics and epidemiology together result in part from increasing attention to those usually chronic diseases in which host or genetic factors appear to be relatively important. The incorporation of genetic concepts and techniques in epidemiological research has added a new dimension to medical demography: the assessment of the genetic endowments of populations.

Human genetics has developed in two areas; each stems from the same principles and laws, but operates on a different level. One, the so-called "pedigree genetics," deals with the individual case, the individual family, or a group of families, and is more directly concerned with preventive medicine. This will be discussed later. The other, "population genetics," transcends the individual case and operates at the population level. It deals with the dynamic balance between mutation and selection in relation to the inherited traits of man, that

is, with population characteristics, which are the stock-in-trade of the epidemiologist.

Following are some of the fields where the geneticist and the epidemiologist together study the natural history of genetically determined disease.

Estimation of Gene Frequencies

Knowledge of the presence of a gene which determines a disease is only a first step toward the study of its natural history. We like to know next the prevalence rate, as this is an indispensable tool for the estimation of the gene frequency by genetic theory and method. Suppose a disease determined by a pair of autosomal recessive genes has a prevalence rate of 1 per 30,000 population in the United States. Such a disease is phenylketonuria (3). According to the Hardy-Weinberg law, the gene frequency of this disease (q) is 1 in 173 and the carrier frequency ($2pq$) is 1 in 86. In other words, 1 person out of 86 in the population is a carrier of the phenylketonuria recessive gene. In England the prevalence rate of phenylketonuria is half that of the United States, 1 per 60,000 population (3). The gene frequency of this disease in England is 1 in 215, and one person out of 122 is a carrier of the recessive gene for phenylketonuria. (Actually the frequencies of phenylketonuria as estimated by Jervis in the United States and Munro in England are 1 in 25,000 and 1 in 50,000 respectively. The figures 1 in 30,000 and 1 in 60,000 presented here were derived by excluding those cases known to have consanguineous parents.)

An estimated gene frequency may not apply to the whole population for which it was estimated because the gene may be present in greater frequency among some subgroups of the population than others. The study of the frequency of thalassemia in Rochester, N.Y., is an example (4). It was found that 11 out of 100,000 children born in the city between 1928 and 1942 were affected with the disease, and from this it would appear that the frequency of the heterozygous carriers would be about 1 out of 50 persons. It so happens, however, that there is a rather large isolate of Italian descent in Rochester, and the 11 cases were of children born within this group. The estimate of the thalassemia gene, therefore, would apply only

Custom-Built Heredity?

Recent advances in research in genetics and biochemistry are described in a series of three articles, which began publication in the September 30, 1959, issue of *Scope Weekly*, as offering high hopes for public health.

In effect, the report says the studies give promise of almost unlimited uses of chemistry to correct physical deficiencies and to strengthen the genetic strain. It notes that awareness of enzymatic defects in metabolism has been coupled with methods of repairing such chemical flaws. Moreover, it cites the discovery of the principle of transduction, the transfer of genetic material from one cell to another, as suggesting possibilities of strengthening resistance to parasites, as well as enlarging the mental and physical potentials of humanity.

Basic ideas that have become apparent from such research were defined by Dr. Edward Lawrie Tatum of Rockefeller Institute, who along with Prof. George W. Beadle of the California Institute of Technology and Dr. Joshua Lederberg, then at Stanford University, was a Nobel medical laureate in 1958. Tatum listed the following concepts:

All biochemical processes in all organisms are under genic control.

These processes are resolvable into a series of individual stepwise reactions.

Each single reaction is controlled in a primary fashion by a single gene: there is a one-to-one correspondence between gene and biochemical reaction.

Therefore, the mutation of a single gene results only in an alteration in the ability of the cell to carry out a single primary chemical reaction.

"Perhaps within our lifetime," he said, "the code of life processes tied up in the structure of proteins and nucleic acids will be broken. This may permit the improvement of all living organisms by processes which we might call biological engineering."

In the same article, Dr. Laurence H. Snyder, president of the University of Hawaii, said that biochemistry and genetics offer a sound approach to diagnosis, prevention, and therapy.

He said there are "reasons for believing that genetics is involved in one way or another in the development of all disease."

to the Italian isolate. The total number of births in the isolate during the 15-year period was estimated to have been in the order of 26,000. The frequency of thalassemia in the Italian subpopulation, then, becomes 1 in about 2,400 and the frequency of the heterozygous carriers 1 in 25 persons.

Another case in point is the frequency of the recessive gene for Tay-Sachs disease which has long been suspected of occurring more frequently among Jewish than among non-Jewish people. Kozinn(5) and his associates in a recent study in the New York City area estimated that the gene frequency for Tay-Sachs disease among Jews is about 1 in 100 and the frequency of carriers about 1 in 50, while for non-Jews the gene frequency is about 1 in 660 and the frequency of carriers about 1 in 300. Another study now being conducted by the National Institute of Neurological Diseases and Blindness, Public Health Service, shows the same trend. Since the homozygote in Tay-Sachs

disease dies before reaching reproductive age, only matings between heterozygous carriers will produce affected children. The chance that two Jewish heterozygotes will marry is the product of their separate probabilities of carrying the gene, or 1 in 2,500. The chance, however, that two non-Jewish carriers will marry is only 1 in 90,000 which, admittedly, is very remote. The task of control and prevention of Tay-Sachs disease is quite different in magnitude and intensity in the two groups.

Estimation of Mutation Rates

Nature tends to maintain a balance of forces between selection and mutation. Selection against deleterious genes occurs either naturally or by eugenic practices. Mutation, however, reintroduces these deleterious genes in the population at a specific rate. It is of great importance, therefore, to know the rate at which normal genes mutate in the population if their control or elimination rate is to be ef-

fective. The tools needed here again are both epidemiological and genetic, for any attempt to arrive at an estimate of the mutation rate of a gene must stem from an accurate knowledge of the incidence rate of the disease determined by the gene in question.

Progressive muscular dystrophy of childhood may serve to illustrate the point. This type of muscular dystrophy is inherited in a sex-linked recessive manner; that is, it occurs only in males who receive the "defective" gene, located on the X (sex) chromosome, from their mothers. The mothers of affected boys act as genetic carriers but are not themselves affected because the defective gene is masked, so to speak, by the normal gene, or allele, located at the same position on the other X chromosome. (Females have two X chromosomes, while males have only one.) Thus mothers who are genetic carriers for childhood progressive muscular dystrophy pass on the gene to half of their sons, who develop the disease, and to half of their daughters, who in turn act as genetic carriers.

The onset is usually in about the third year of life and its progress is so rapid that the affected children are invalids by the time they reach 10 to 12 years of age. Few live past the age of 20 years. In spite of the fact that the gene is eliminated with the death of the affected individual before he reaches reproductive age, the frequency of the disease does not change appreciably in the population, and a rather high mutation rate would be required to maintain it at a constant level. Stephens (6) and his associates estimated the mutation rate by ascertaining the number of dystrophics born in Utah during the 10-year period 1931-41. There were 18 such cases, and 6 of these were considered as new mutations because there was good evidence that the gene had not been passed down through a line of female carriers to the affected individuals. Approximately 126,000 children were born in the State during that period. If half of them were males, then 6/63,000 gives the approximate mutation rate per X chromosome per generation. The estimate is 9.5×10^{-5} , or about 1 mutation per 10,000 male births.

The epidemiological-genetic cooperative approach during the last few years has been

instrumental in enabling us to estimate the mutation rates of the genes responsible for many diseases. Some of these estimated mutation rates in man are summarized below:

Condition produced by gene	Mutation rate per million genes per generation
Autosomal dominant:	
Epiloia -----	8
Chondrodystrophy -----	42
Pelger's nuclear anomaly -----	80
Aniridia -----	5
Retinoblastoma -----	14
Autosomal recessive ¹ :	
Albinism -----	28
Congenital total color blindness -----	28
Tay-Sachs disease -----	11
Ichthyosis congenita -----	11
Cystic fibrosis of the pancreas -----	700
Amyotonia congenita -----	20
Sex-linked recessive:	
Hemophilia -----	32
Pseudohypertrophic muscular dystrophy -----	95

¹ The general feeling among investigators currently is that mutation rate estimates for autosomal recessive genes may not be valid because of unknown heterozygote effects. If, for example, the heterozygote has a slight advantage sufficient to perpetuate a rare recessive lethal gene in the absence of mutation, then the estimate of the mutation rate would appear to be too high.

Selective Advantage of a Genotype

It has been known from experimental work in lower animals, especially in *Drosophila*, that the heterozygous condition of certain traits may have some selective advantage, that is, be reproductively superior, over either dominant or recessive homozygote. This phenomenon is known in genetic terms as "balanced polymorphism." Although it has been suspected for a long time that balanced polymorphism may operate in man, the first instance of such selective advantage in a human population was dramatically demonstrated by Allison (7) in 1954 with his work on sickle-cell anemia. This disease is genetically determined by a pair of incompletely dominant genes (genes which in the heterozygote produce detectable phenotypic effects). In the homozygous condition, the gene results in a severe, chronic hemolytic anemia which is often fatal before puberty.

In the heterozygous condition, the clinical picture is known as sickle-cell trait and results

in a variable syndrome which is compatible with survival. The gene is apparently much more frequent in Negroes than in whites. It is present in 10 percent of American Negroes, and 1 out of 500 of them is affected with sickle-cell anemia. Allison noted that in spite of the mass elimination of the recessive gene because of its lethality in the homozygous condition, its frequency was abnormally high in certain regions of Africa. This could be explained either on the basis of a high rate of mutation which would reintroduce the gene in the population or by attributing to the heterozygote some selective advantage. Indeed, Allison showed by both observation and experiment that in some regions of central Africa in which the frequency of the gene was very high, the heterozygous state afforded protection from falciparum malaria, which is endemic in those areas. Allison also observed that sickle-cell trait frequencies of 30-40 percent occur in geographically widely separated tribes in Africa and that these tribes are characteristically found in intensely malarious regions. He calculated that the reproductive fitness of the heterozygote must be 1.26 times that of the normal homozygote for an equilibrium to be maintained under these conditions.

Investigations along these lines have barely begun. It is possible that the distribution of many other genetic diseases and the gene frequencies that perpetuate them can be explained by balanced polymorphism. The question should be pursued by epidemiological-genetic methods.

Effects of Geographic Factors

It is well known and accepted as axiomatic that heredity alone is incapable of producing any character; the character in question will appear only if an optimal environment makes its expression possible. A study of environmental conditions, therefore, is essential for the complete understanding of the natural history of a genetically determined disease.

One environmental factor is geographic. Recently Mackay and Myrianthopoulos (8) presented evidence favoring genetic determination of multiple sclerosis. Although they could not postulate a mode of inheritance, they noted, after preliminary analysis of the affected sib-

lings and first cousins of their propoiti, that the hereditary factors involved must operate with greatly reduced penetrance. Earlier, Kurland and Westlund (9) demonstrated that multiple sclerosis was more prevalent in cold northern climates than in warm southern ones. It is possible that a correlation exists between penetrance and geographic distribution in multiple sclerosis.

Geographic isolation continues to be one of the most important factors in differential distribution of gene frequencies. On the island of Guam, for example, amyotrophic lateral sclerosis is responsible for approximately 10 percent of the deaths, while in the United States amyotrophic lateral sclerosis is estimated as the cause of death in only 0.1 percent of the population. There is good reason to believe that the majority of cases on Guam are genetically determined, while in the United States only a small proportion of cases are found to have positive family history. Whether the geographic isolation, the population size, or other environmental conditions are responsible for the high prevalence of amyotrophic lateral sclerosis on Guam, it is the natural responsibility of the epidemiological-genetic team to investigate.

Genetics and Preventive Medicine

The contributions which genetics has made to many facets of preventive medicine, especially diagnosis and treatment, are well recognized. For example, understanding of the genetics of the Rh factor by physicians and parents has aided in saving thousands of newborn babies that might have perished from erythroblastosis fetalis. Most physicians now routinely include a "family history" in the anamnesis of events of their patients' histories, and some even consider it a deciding factor in differential diagnosis.

Other possible applications of genetics to preventive medicine are not as widely appreciated. In many respects they constitute an untapped source of valuable information in the fight against disease.

Detection of Heterozygous Carriers

Heterozygous carriers, as the term is used here, means not only the carriers of recessive

genes in the heterozygous condition but also the carriers of dominant genes for diseases which have a late onset, such as Huntington's chorea or progressive muscular atrophy. The importance of being able to recognize these individuals who have the potentiality either to produce affected children or become affected themselves is self-evident.

In our search for signs or symptoms by which we would be able to identify the heterozygote, we are presently limited to the observation of recognizable morphological deviations or to the identification of detectable biochemical deviations from the normal. More often than not, these are elusive either because they are so minute as to be considered insignificant or because they occur in areas in which they are inaccessible and unsuspected. In spite of these difficulties, progress toward the recognition of the heterozygous state has been considerable for a good number of diseases. In some cases the heterozygote can be detected with 100 percent accuracy. In others, the degree of accuracy is much less.

On the basis of our ability to recognize the heterozygous state, genetic diseases can be classified in three categories.

First are those conditions in which the heterozygous state produces a recognizable clinical picture, albeit not as severe as that produced by the homozygous conditions. In this category belong the by now classic sickle-cell anemia which in the heterozygote is manifested as a sickle-cell trait; and thalassemia major which in the heterozygote is manifested as thalassemia minor.

Second are those conditions in which the carrier state is characterized by a subclinical effect with corresponding slight phenotypic change which can be detected with appropriate known and available tests. In this category belong gout whose carrier state shows only hyperuricemia; hereditary hemolytic jaundice which in the carrier state is characterized by asymptomatic spherocytosis; xanthomatosis in which the heterozygote shows hypercholesterolemia.

Finally are those conditions for which the carrier state can be recognized in some but not in all cases. Dystrophia myotonica, Huntington's chorea, galactosemia, Friedreich's ataxia, hemophilia, and a score of other conditions be-

long in this group. For some of these the rate of the detection of the heterozygote comes close to the genetic expectation while for others the degree of accuracy is small. This is not surprising since, as previously mentioned, for most of these conditions the detection of the heterozygote probably depends on the recognition of minute or subtle biochemical deviations which presently available techniques cannot assess accurately.

Neel and Schull (2) compiled a list of diseases in which it may be possible to recognize the carrier state. They devised a grading system of 1-4 to indicate the reliability of recognition of the carrier state, grade 1 being the most reliable and grade 4 the least reliable.

Whatever information is available now, even for diseases in the less reliable grades, can be very useful, when interpreted by an experienced worker, in preventive medicine and especially in genetic counseling. With the perfection of such methods as tolerance tests and the refinement of bioassay methods, it may become possible to detect accurately the heterozygote for many genetic diseases.

Genetics and Metabolism

Modern genetics has particularly studied the ways in which genes act. There is abundant accumulated evidence that genes produce their effects through metabolic pathways. The original investigations in this field by Beadle and Tatum with the mold *Neurospora* won them the Nobel Prize for medicine in 1958. Actually, Sir Archibald Garrod can be regarded as the prodrome of biochemical genetics, for he first drew attention to what he called "inborn errors of metabolism" as far back as 1908. The inherited diseases based on metabolic abnormalities which Garrod described were: alcaptonuria, cystinuria, albinism, porphyria, and pentosuria.

Today a large number of diseases are believed to result from hereditary flaws in protein, carbohydrate, or fat metabolism. For a good number of these diseases, investigators have identified the enzymatic level where occur the metabolic blocks controlled by genes. It is easy to see the significance of such precise knowledge for now the problem can be attacked

at its roots. Two examples cited here illustrate the possibilities.

Phenylketonuria is a metabolic disorder in which, due to metabolic deficiency, there is a failure of transformation of phenylalanine to tyrosine. This block is controlled by a pair of autosomal recessive genes. The molecule whose dysfunction is responsible for this failure is a liver enzyme concerned with the oxidation of phenylalanine. The disturbance is present at birth and is characterized by elimination of phenylpyruvic acid in the urine, various neurological signs, and mental deficiency. Several attempts are now being made to treat children suffering from phenylketonuria with a special diet, free of phenylalanine. Although it is early yet for full evaluation of this treatment, encouraging results have been reported. The present status of the situation has recently been reviewed by Knox and Hsia (10).

Galactosemia, or idiopathic galactosuria, is another metabolic disorder of infants apparently dependent on a pair of recessive genes. It is the result of an inability to convert galactose, a component of milk sugar, into glycogen due to a decrease or absence of the hepatic enzyme Gal-1-P uridyl transferase. The disease is accompanied by severe clinical symptoms such as failure to gain weight, hepatomegaly, jaundice, diarrhea, vomiting, albuminuria, and zonular cataract. When galactosemia is correctly diagnosed, it is often enough to remove galactose from the diet and the clinical manifestations, which otherwise may have serious consequences, disappear.

An opinion shared by many geneticists and biochemists is that all genetically determined diseases are metabolic in origin. If this be true, then as biochemical techniques become more refined and precise, research should be able to uncover the underlying metabolic defect not only in the affected individuals but also in the heterozygous carriers.

Genetic Counseling

Genetic counseling not only has potential importance in the prevention of genetic disease, but also helps to dispel false fears about hereditary traits. The primary function of genetic counseling is to provide people with information regarding their genetic problems.

The physician should be the person most qualified to give genetic advice. He is thoroughly versed in medical matters and also knows intimately the personalities and needs of his clients. Unfortunately, few physicians are trained to give professional advice in genetic problems. Medical schools seldom offer formal training in medical genetics. Neither do they ask for courses in general or human genetics as entrance requirements.

Some of the institutions which have given serious consideration to the teaching of human genetics and the training of scientists in this field have established genetic counseling centers where physicians can refer their patients for counseling and where genetic problems per-

Genetic Counselors and Counseling Centers in the United States and Canada

- P. DAVID: University of Oklahoma, Norman.
F. C. FRASER: Department of Medical Genetics, Montreal Children's Hospital, Canada.
E. J. GARDNER: Department of Zoology, Utah State Agricultural College, Logan.
C. N. HERNDON: Department of Medical Genetics, Bowman Gray School of Medicine, Winston-Salem, N.C.
F. KALLMANN: New York State Psychiatric Institute, New York City.
H. W. KLOEPFER: Tulane University, New Orleans, La.
N. C. MYRIANTHOPOULOS: Genetic Counseling and Research Center, George Washington University Hospital, Washington, D.C.
J. V. NEEL: Heredity Clinic, University of Michigan, Ann Arbor.
C. P. OLIVER: Genetics Foundation, University of Texas, Austin.
S. C. REED: Dight Institute, University of Minnesota, Minneapolis.
F. E. STEPHENS: Laboratory of Human Genetics, University of Utah, Salt Lake City.
C. STERN: University of California, Berkeley.
K. A. STILES: Zoology Department, Michigan State College, East Lansing.
N. F. WALKER: Hospital for Sick Children, Toronto, Canada.
-

taining to the individual, the family, and the community can be handled. There are about a dozen or more such centers in the United States, less than 1 per 10 million people (see list).

No two of the problems which confront the genetic counselor are the same even if they involve identical conditions. Obviously, the people who seek genetic counseling differ in each case with respect to physical and mental makeup, social and economic background, educational level, religious upbringing, and emotional content. Requests for counseling may be anticipatory, as with people contemplating marriage who know that a certain disease exists in one of the families. They would want to know what the chances are that their future children may inherit this disease. Some persons seek genetic counseling inevitably "after the fact," that is, after they have had one or more affected children. In these cases, the condition is usually recessive and the parents not affected. They find that they are genetic carriers when they have one affected child, and they are concerned about the chances of repeating their misfortune.

Many requests for counseling concern children to be placed for adoption. The adoption agency or the prospective parents want to know whether the child is a good adoptive risk, especially if it is known that there has been some undesirable trait in the child's family, such as epilepsy or mental deficiency.

The counselor's job is often complicated by situations which result from irregular action and expression of genes. Some conditions, such as peroneal muscular atrophy, show reduced penetrance; others, such as Friedreich's ataxia and retinitis pigmentosa, are inherited in more than one way; in still others, such as central nervous system malformations, the complex interaction between heredity and environment distorts the genetic ratios to such a degree that a precise evaluation of each component is impossible. The counselor has to consider all of these, and at times he has to resort to empiric risk figures in order to give effective advice. As Reed (11) put it, "It has been our lot to struggle with such complicated traits as schizophrenia, in which the heredity seems to be that of an in-

complete dominant with incomplete penetrance. This sounds too incomplete for words and the impatient soul may decide to toss out the genes altogether."

These difficulties are listed here only to show that the quality of genetic advice depends on thorough mastery of the subject matter in all its known intricate details. Genetic counseling without competent and scientific training in this field may be disastrous to the individual, defeating the whole objective of the profession.

Comment

It is evident that genetics has become an important adjunct to public health practice, teaching, and research. Even so, in some of the areas, such as the detection of the heterozygote or the understanding of the metabolic etiology of disease, the surface has barely been scratched.

The manpower needs are now acutely felt. There is a serious shortage of well-trained human and medical geneticists. In the United States and Canada hardly a dozen institutions offer adequate training in human genetics. There is need for the establishment and support of many more training institutions. There is need for the introduction of courses in human and medical genetics in our medical and public health schools. There is need for the establishment of genetic counseling centers at convenient locations to serve all the people. Only such efforts can realize the potential of genetics in contributing toward the reduction of chronic disease and improvement of public welfare.

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Signs and Symptoms

Farm women in Maryland received instruction this summer in safe handling of gasoline engines, tractors, and other farm equipment, at a series of classes conducted throughout the State by Guy W. Gienger, agricultural engineer with the University of Maryland.

» «

Foster homes for New York City's aged have been provided for nearly 15 years by the New York City Department of Welfare. A few voluntary agencies also have foster home programs on a limited scale.

Foster homes meeting prescribed standards are needed for those older or handicapped individuals who require a semiprotected living arrangement but who neither desire nor need the institutional setting for congregate living.

Proprietors of foster homes in the Department of Welfare's supervised program currently receive \$100 a month for single accommodations and \$90 a month when two boarders share a room. The fee includes room, board, and personal service which may be required by the older or handicapped person.

» «

Yellow fever can be diagnosed in experimental animals within 24 hours after infection by means of histopathological examinations and use of the fluorescent antibody technique, Dr. H. F. Smetana of the Armed Forces Institute of Pathology, Washington, D.C., told a joint meeting of the American Society of Clinical Pathologists and the College of American Pathologists in Chicago.

A full report of papers delivered for the Council on National Defense at the American Medical Association meeting, June 6, 1959, appears in the September 12, 1959, issue of the *Journal of the American Medical Association*. The same issue carries a report on the epidemiology of mental health by Milton Olin, which concludes with a quotation from Dr. Will Menninger: "We live in a turbulent world, a crazy world, with many evidences of man's hostility to man But it is our world; it is what we are making it; and its course depends on the responsibility that you and I assume for it."

» «

Automobile accidents caused approximately 35 percent of all deaths of persons aged 15 through 24 years in the United States during 1957, according to the accident prevention program of the Public Health Service.

» «

The first patients have been admitted to New York State's research unit in narcotic addiction at Manhattan State Hospital, Ward's Island, New York City. According to Commissioner of Mental Hygiene Paul H. Hoch, the unit is the first full-time narcotics research unit in the State combining laboratory investigations and outpatient and inpatient operations. There are 55 beds for inpatients, and about 150 outpatients can be treated.

Organized for research purposes, the unit's staff will concentrate on basic investigations in an effort to determine causes of addiction and to improve treatment methods.

A wristwatch with a band too tight for the wearer was found by Dr. Howard R. Bierman to be the cause of a progressive unilateral neuritis of the thumb and index finger in an otherwise healthy woman, it was reported in the *New England Journal of Medicine*, July 30, 1959.

» «

Foresighted Florida physicians started in 1873 to campaign for a State board of health, but it took 16 years and Jacksonville's paralyzing yellow fever epidemic in 1888 to bring the board into being. This and other events in the history of public health in Florida came to light recently when a wooden packing case labeled "for posterity" and containing correspondence from the early days was found under the eaves of a State building. The origins and growth of public health in Florida were reviewed in the September 1959 issue of *Florida Health Notes*, introduced in July 1892 as a personal project of Dr. Joseph Y. Porter, the first State health officer, and his assistant, Dr. Hiram Byrd.

» «

The art of screening for glaucoma, a combined effort of health officials and the Lions Club of Brookline, Mass., is described by John G. McCormick in *Health Educators at Work*, May 1959. From the basic planning and preparatory information campaign, through the personal courtesies provided at the clinic and evaluation, this is a lucid, blow-by-blow community case history.

STATEMENT

*By Arthur S. Flemming, Secretary of Health,
Education, and Welfare, August 26, 1959*

The Federal Radiation Council

As most of you are probably aware, the President on August 14, 1959, issued an Executive order establishing the Federal Radiation Council, and along with the order the White House issued a press release which elaborated upon the order.

On August 22, the White House issued a second press release in which I had the honor of being designated by the President as the current chairman of the Federal Radiation Council. That press release also stated:

"The President also directed that the Department of Health, Education, and Welfare intensify its radiological health efforts and have primary responsibility within the executive branch for the collation, analysis, and interpretation of data on environmental radiation levels such as natural background, radiography, medical and industrial use of isotopes and X-rays, and fallout, so that the Secretary of Health, Education, and Welfare may advise the President and the general public."

The action of the President, as reflected in the three documents referred to above, constitutes, in my opinion, a constructive and effective method for dealing with the growing problems of radiological health protection.

Under the President's directive, the existing work of this Department in the radiological health field will be intensified, and the Department will undertake the additional "primary responsibility within the executive branch for the collation, analysis, and interpretation of data on environmental radiation levels . . ."

As a first step in organizing the Department for our expanding work, I have made specific delegations of responsibilities for radiological health activities. These responsibilities, which primarily concern the Public Health Service and the Food and Drug Administration, are

spelled out in the "Manual of General Program Policy—Part 10, Radiation Health," dated August 1959. This is being made a part of the Department's internal manual in which general program policy is set forth.

It should be noted that I have assigned to the Public Health Service the responsibility for "collation, analysis, and interpretation of data on environmental radiation levels as a basis for the Secretary's advice to the President and the general public."

Financial ability, of course, is always an important factor in undertaking new work. For the current fiscal year we have funds available as shown below. For comparison I have also listed the funds that were available in the preceding fiscal year.

	<i>Fiscal year 1959 (actual)</i>	<i>Fiscal year 1960 (available)</i>
Food and Drug Administration-----	\$78, 500	\$400, 000
Public Health Service :		
Division of Radiological Health-----	634, 100	2, 489, 100
General research and services-----	289, 000	300, 000
Cancer research ¹ -----	15, 000	15, 000
Total -----	\$1, 016, 600	\$3, 204, 100

¹ Represents costs of a special study of the effects of uranium radiation on uranium miners.

It will be noted that the 1960 funds are a substantial increase over the funds for 1959.

In addition to the funds identified in the table, the National Institutes of Health also expend funds for therapeutic and diagnostic services in the radiological field. For 1960, the funds available for this purpose total \$3,000,000.

In allocating the funds for 1960, careful consideration will be given to the new assignments given to the Department by the President. As

soon as I know how far we can go in carrying out the President's assignments with available funds, I will give consideration to the question of requesting additional funds. It is not necessary for me to cross this bridge at the present time, because such a request cannot be adequately developed and considered until the Congress reconvenes in January.

The Department approaches its expanding role in the radiological health field with the most serious determination to carry out the President's assignment. At the same time, we are sensitive to the complexities involved in the subject, and we have the utmost respect for the labors of the pioneers, both in and out of government, who have preceded us.

Summary of a Doctoral Dissertation

LONGITUDINAL STUDIES OF TUBERCULOSIS PATIENTS REGISTERED IN HAWAII: FACTORS IN SURVIVAL RATES

Survival patterns of tuberculosis patients were investigated. The material was supplied by the history of 4,909 persons placed on the Hawaii tuberculosis case register during the period of January 1, 1947 to June 30, 1953. Various patient-cohorts were categorized by medical and demographic characteristics on registration and by mode of detection of the patient. Survival rates were computed for successive periods after registration for each cohort by methods of analysis which eliminate all competing causes of removal from the register other than death from tuberculosis. The "net" survival rate, so obtained, was used for the comparison of risks of death from tuberculosis in different patient-cohorts.

Of the total study population, 91 percent were alive 6½ years after registration. Patients whose disease was "active" on registration showed a much lower survival rate than did the "nonactive" patients. The rate of mortality from tuberculosis diminished with time after registration, particularly for the "active" patient. The significance of "activity undetermined" seemed dubious from the survival pattern. A clear time trend was noticed for

survivorship improving with year of registration, especially in "active" patients.

The survivorship differed by certain medical and demographic factors. In general, the variation was relatively large in "active" patients but it was relatively slight in "nonactive" patients. The survival rate varied more strongly by bacteriological finding than by clinical sign of activity status of the disease. The mortality was greatest for far advanced active patients.

Survivorship was relatively low for the first five years of life, rose to a maximum at the 15-24 age group, and then decreased with age. Little difference in survival by sex was noticed within specific age groups. The mortality peak observable with the group of adolescents and young adults in the general population, especially in the developing countries, may be due to excessive exposure rather than lowered resistance. Survivorship varied considerably by race.

Patients detected by minifilm surveys had more favorable survival rates than those first diagnosed because of "symptoms."—CHAI BIN PARK, M.D., M.P.H., Ph.D., *University of California*, 1959.

Chlorinated Organic Pesticide Residues in Fluid Milk

PAUL A. CLIFFORD, JONAS L. BASSEN, and PAUL A. MILLS

DURING the 4-month period August through November 1958, the Food and Drug Administration conducted a nationwide survey of antibiotic and pesticide residues in raw fluid milk in cooperation with many State, county, and municipal milk control officials.

A total of 936 raw milk samples from 16 Food and Drug Administration Districts were tested for residues of chlorinated organic pesticides. Twenty-three showed residues of 0.1 ppm or more. The findings on antibiotic residues have recently been published (1).

An earlier survey (1955) of antibiotic and pesticide residues in fluid milk by the Food and Drug Administration (2, 3) revealed that 62 percent of the 800 samples tested contained pesticide residues. The samples consisted of pasteurized milk collected at dairies in retail cartons or bottles; thus it was not possible to correlate samples which bore residues with a specific group of producers and thereby to pinpoint the source of contamination.

The results of the 1955 survey were made available to milk control officials, milk industry associations, and the Federal Extension Service of the U.S. Department of Agriculture. The Food and Drug Administration encouraged each group to conduct an educational campaign to promote the safe use of pesticides on dairy farms.

Cooperation was excellent. The four regional committees of State Extension Dairy-men, meeting with State Extension Directors and representatives of the U.S. Department of Agriculture in the spring of 1957, adopted a series of recommendations for eliminating antibiotic and pesticide residues from the milk

supply. One of the recommendations was that the Food and Drug Administration continue its surveys.

County agents were encouraged to hold meetings with dairymen. The American Butter Institute, with the assistance of the Food and Drug Administration, prepared a leaflet entitled "Safe Use of Pesticides on Dairy Farms." The leaflet received wide distribution and its message was reprinted in several national farm journals. Other milk industry associations and local national farm organizations conducted an educational campaign among their members.

In planning the present survey the Food and Drug Administration had the active cooperation of State, county, or municipal milk control officials in those areas selected as sampling stations. The Food and Drug Administration supplied the methods of analysis used in the survey for pesticide residues to interested milk control officials and dairy plant managers (4, 5).

Objectives and Plan of the Survey

This survey extended beyond the determination of the incidence and range of pesticide residues in fluid milk. A main objective was to find the source of pesticide residues in all samples containing substantial amounts of any chlorinated organic pesticide. "Substantial"

The authors are with the Food and Drug Administration, Mr. Clifford serving as assistant to the director of the Bureau of Biological and Physical Sciences, Mr. Bassen as food and drug officer in the Bureau of Program Planning and Appraisal, and Mr. Mills as chemist in the Division of Food.

amounts, for this survey, were fixed at 0.1 ppm or more of pesticide residues. We were also anxious to test the value of another chemical screening procedure, namely, paper chromatography, as a control method for the average laboratory. We hoped to detect any seasonal differences in the occurrence of pesticide residues by conducting the survey over a 4-month period; thus from August through November there would be a change in the cow's diet from predominantly pasture to bulk and solid feeds. By including all 16 Food and Drug Administration Districts in the survey, the results might reveal differences in the incidence of pesticide residues in various parts of the United States.

Each Food and Drug Administration District, with the assistance of State and local milk control officials, selected one city in its territory in which to conduct the survey. The cities surveyed and the headquarters of the Food and Drug Administration District in which they are located were: Atlanta, Ga. (Atlanta); Washington, D.C. (Baltimore); Providence, R.I. (Boston); Buffalo, N.Y. (Buffalo); Chicago, Ill. (Chicago); Cincinnati, Ohio (Cincinnati); Denver, Colo. (Denver); Wichita, Kans. (Kansas City); Minneapolis, Minn. (Minneapolis); Los Angeles, Calif. (Los Angeles); New Orleans, La. (New Orleans); Metropolitan New York City (New York); Trenton and Camden, N.J. (Philadelphia); St. Louis, Mo. (St. Louis); San Francisco, Calif. (San Francisco); Seattle, Wash. (Seattle).

In each of these cities, three dairy plants were selected as monthly sampling stations. Thus, 48 sampling stations were included in the survey. Criteria used in selection were (a) an interest and desire on the part of management to cooperate in the survey; (b) a minimum of five milk pickup routes; and (c) feasibility of identifying each producer on each pickup route.

The survey was divided into three phases; phase A, the collection of fluid milk samples from bulk farm tank trucks (a few samples were composites from can routes) at each dairy; phase B, the collection of milk samples from individual producers from the pickup route found to contain "substantial" pesticide residues; and phase C, a visit to the farm pro-

ducer whose milk collected under phase B contained "substantial" residues.

Under phase A, starting in August, 1-quart samples of milk from five milk pickup routes were collected monthly at each dairy. In subsequent months, five additional routes were to be sampled, so that over the 4-month survey period all or nearly all routes were sampled at least once. Among the selected dairy plants the number of routes varied from 5 with an average of 8 producers to 54 with an average of 20 producers. Thus, more intensive testing of the milk supply was possible at those plants with a small number of milk routes. For example, one dairy plant in San Francisco had only five routes and each route was resampled every month for 100 percent coverage of the milk supply. On the other hand, at a dairy plant in Cincinnati with 54 routes, only 20 routes were sampled during the survey period.

Analytical Methods

The samples were initially analyzed by paper chromatography (4,5) for residues of DDT, DDE, DDD, lindane, BHC, dieldrin, chlordane, methoxychlor, toxaphene, and heptachlor. Samples with substantial residues, that is, an estimated 0.1 ppm or more, were analyzed by more exact quantitative methods. Where available, official quantitative methods of the Association of Official Agricultural Chemists were used. Paper chromatography gives only semi-quantitative results which are not directly comparable with the results obtained by specific quantitative methods.

Successful application of paper chromatography to milk fat demands a rigorous sample "cleanup" which involves the isolation of microgram quantities of pesticide from all but traces of fatty residues. The cleanup requires steps in which losses of pesticide are almost certainly bound to occur, namely, the acetonitrile partition, the chromatography through adsorbent columns, and the evaporation of the relatively large volumes of solvents.

Thus, the usefulness of paper chromatography as a screening procedure depends on the probability of not missing samples containing substantial residues. Of the 23 phase A samples found by the districts to contain substan-

tial residues by paper chromatography, 17 were also analyzed by the appropriate quantitative method. Four of the 17 samples showed no residues. Obviously, these samples can only indicate the extent of false positive results by chromatography whereas we are also concerned with false negatives. A number of districts analyzed some negative phase A and B samples by both paper chromatography and by quantitative methods. Of the 49 samples, there were no false negative results, that is, cases in which the quantitative method revealed substantial residues and paper chromatography did not.

Results

Of a total of 936 phase A samples, 23, or 2.5 percent, contained substantial amounts of residue (an estimated 0.1 ppm or more). DDT, DDE, and DDD were most commonly found. Toxaphene, chlordane, and BHC were encountered less frequently. The results for each district for the 4-month period are given in table 1. No trend was noted toward a higher incidence of samples with substantial residues during any particular month.

During October and November, each district submitted 10 duplicate samples to the Food and Drug Administration's Division of Food for check analysis. These were analyzed by paper chromatography and by fly bioassay. Table 2 summarizes the results by the two methods. By paper chromatography, the Division of Food found substantial residues in 5 of 168 samples (3.0 percent). This figure compares well with that found by the districts. DDT and DDE, DDD, dieldrin, chlordane, BHC, and lindane were found in that order. Indications of aldrin and of heptachlor or its epoxide or both were noted in a few cases. The florasil column eluates of 67 percent of the samples produced no symptoms in flies. Fifteen percent of these eluates caused mortality of more than 10 percent (more than 10 of 100 flies). The MgO column eluates caused no symptoms in 46 percent of the cases and mortality of more than 10 percent in 39 percent of the cases. The higher mortality for the MgO eluates may be due to minute traces of dieldrin, aldrin, or heptachlor epoxide; flies are especially sensitive to these pesticides.

Ten districts found one or more phase A

Table 1. Results on phase A samples examined by Food and Drug Administration Districts

FDA District	Chromatography				Identified by chromatography ¹				
	Number of samples	Number negative or with trace amounts	Number with substantial amounts	Percent with substantial amounts by districts	DDT	BHC	Toxaphene	Chlordane	DDD (TDE)
Atlanta	60	60	0	0					
Baltimore	60	58	2	3.3	1		1		
Boston	60	59	1	1.6		1			
Buffalo	60	59	1	1.6			1		
Chicago	60	60	0	0					
Cincinnati	60	57	3	5.0	2		1		
Denver	60	59	1	1.6	1				
Kansas City	60	55	5	8.3	3			2	
Los Angeles	60	60	0	0					
Minneapolis	30	30	0	0					
New Orleans	60	59	1	1.6	1				
New York	60	59	1	1.6	1				
Philadelphia	60	57	3	5.0	1				2
St. Louis	64	64	0	0					
San Francisco	62	57	5	4.2	² 5				
Seattle	60	60	0	0					
Total	936	913	23	2.5	15	1	3	2	2

¹ Samples with substantial amounts only.

² Some conversion to DDD.

Table 2. Results by Food and Drug Administration's Division of Food on 1958 check of milk samples

FDA District	Number of samples	Chromatography					Fly bioassay					
		Florisol column			MgO column ¹		Florisol column			MgO column		
		Number negative	Number showing traces	Number with significant amounts	Number negative	Number showing traces	No symptoms	Mortality <10 percent	Mortality >10 percent	No symptoms	Mortality <10 percent	Mortality >10 percent
Atlanta.....	10		10				8	1	1	3	1	6
Baltimore.....	12		12			12	9	1	2	1	1	10
Boston.....	10	4	6				5	5	0	7	3	0
Buffalo.....	10	4	6		4	6	4	3	3	4	5	1
Chicago.....	10	4	6				10	0	0	8	0	2
Cincinnati.....	10	4	6		5	5	10	0	0	10	0	0
Denver.....	10	5	5		2	8	5	5	0	1	0	9
Kansas City.....	10	2	8				10	0	0	15	0	5
Los Angeles.....	10		10				6	1	3	6	4	0
Minneapolis.....	9		9			9	9	0	0	9	0	0
New Orleans.....	10	6	4		5	5	9	1	0	8	1	1
New York.....	10	1	8	1	3	7	4	1	5	2	2	6
Philadelphia.....	10		10			10	7	1	2	0	0	10
St. Louis.....	17	6	11		7	10	4	9	4	6	7	4
San Francisco.....	10		7	3			4	1	5	2	1	7
Seattle.....	10		9	1			9	0	1	5	0	5
Total.....	168	36	127	5	26	72	113	29	26	77	25	66
Percent.....		21.4	75.6	3.0	(²)	(²)	67.3	17.3	15.5	45.8	14.9	39.3

¹ None showed significant amounts.

² Percentages not computed because of insufficiency of data.

samples to contain substantial residues. Nine of these districts proceeded to collect phase B followup samples. In table 3 are given the number of phase B samples collected by each of these districts and the results. Some of the negative results on the phase B samples may be attributed to a transient contamination with pesticide residues or to a delay in followup.

The eight producers whose milk was found to contain substantial residues in phase B were visited by Food and Drug Administration inspectors, usually accompanied by a State or local milk inspector, under phase C of the survey. The producers were questioned about their spraying practices around and in the barn, type and source of feed, and other likely sources of contamination. Samples of milk in all cases, and feed materials where indicated, were collected and analyzed for pesticide residues.

The Baltimore District investigated two producers in January 1959. Milk samples from these farms were negative for pesticide resi-

dues. The cows on both farms were fed a similar diet consisting of mixed dairy feed, clover or alfalfa hay or both, and grass or alfalfa silage. On one farm only one item, clover hay, was found to contain traces of DDT. On the other farm, alfalfa hay and alfalfa silage contained traces of toxaphene.

The Kansas City District investigated two producers under phase C. These producers were delivering milk to two different dairies. Followup at one farm revealed no detectable pesticide residues in any of the samples of hay, grain, and silage being fed. The sample of milk collected at the farm contained 0.03 ppm DDT. The source of the DDT in this producer's milk might have remained a mystery except for the investigation of the second producer. At the latter farm, samples of milk, hay, mixed grain, and silage were collected. The mixed grain, of intrastate origin, contained 0.32 ppm DDT and the milk, 0.3 ppm DDT. On questioning this farmer, the inspector learn-

ed that a commercial exterminator had sprayed this farmer's barn. The inspector visited the exterminator and found that he had sprayed a number of barns in the area with a 0.5 percent DDT solution. He acknowledged knowing that use of DDT around dairy barns was prohibited but finally admitted that he had used DDT because it was cheaper than some of the pesticides approved for use in dairy barns. Among the producers whose barns were sprayed by this exterminator, the inspector found the name of the first producer he had visited.

The New Orleans District investigated one producer under phase C. None of the feed materials—whole corn, wheat shorts, and cottonseed meal—contained pesticide residues although the milk contained 0.06 ppm DDT. A tentative explanation was contamination of pasture with DDT from an unknown source.

The San Francisco District found two producers' milk on one bulk tank route to contain substantial residues of DDT and DDD. Joint inspections were undertaken in December 1958 by the Food and Drug Administration, California Bureau of Dairy Inspection Services, and the fieldman of the dairy bottling plant which received this milk. At one producer's, no substantial residues were found in the milk. The second producer's milk contained 6.3 ppm DDT (8.0 ppm calculated as DDD). Subsequent samples of milk and corn silage from this producer, analyzed by the State Bureau of Dairy

Inspection, revealed 4.8 ppm DDT in the milk and 12 ppm DDT in the silage. The State Bureau of Dairy Services suspended this producer from shipping milk. After this producer's milk was eliminated, a retest of the bulk tank route revealed only trace amounts of DDT. Contaminated corn silage grown on the producer's farm was the source of the pesticide residue in the milk.

The milk of the producer on the second route investigated by San Francisco District in February 1959 contained 2.0 ppm DDT. A sample of alfalfa hay being fed to the herd did not contain detectable residues of DDT. The inspection did not reveal the source of pesticide residue in this producer's milk supply.

Discussion

Although it is difficult to compare the findings in this survey with those in the 1955 survey because more sensitive procedures have since been devised, it is quite clear that there has been a definite improvement in the milk residue picture. As in the 1955 survey, DDT was the most notorious offender in the current survey. Where the sensitive bioassay procedure was employed in essentially the same manner in both surveys (florisil column, table 2) 33 percent of the 1958 samples gave a positive test (which includes trace amounts) for chlorinated organic pesticide residues, as compared with 62 percent in the 1955 survey. Moreover, in the 1955 survey the samples consisted of market milk pasteurized and ready for the consumer; in other words, they represented the mixed output of many individual producers.

In the 1958 survey the primary purpose was to pinpoint the source of contamination. The samples were drawn from bulk tank trucks in which was mixed the raw milk output of only a few producers, generally less than a dozen. Thus, in the 1958 survey one might have expected a higher incidence of very excessive residues, but we did not find this.

Summary

In a 1958 survey conducted by the Food and Drug Administration, 936 samples of raw milk

Table 3. Results on phase B samples

FDA District	Number of bulk tank routes sampled	Number of samples	Number with less than 0.1 ppm	Number with substantial residues
Baltimore-----	2	21	19	2
Boston-----	1	9	9	0
Buffalo-----	1	10	10	0
Denver-----	1	11	11	0
Kansas City----	2	17	16	1
New Orleans----	1	2	1	1
New York-----	1	12	12	0
Philadelphia----	1	13	13	0
San Francisco--	2	21	18	3
Total-----	12	116	109	¹ 7

¹ Percent of samples with substantial residues: 6.0.

from 48 dairies in 16 metropolitan areas in all sections of the United States were analyzed by the 16 Food and Drug Administration's Districts for residues of chlorinated organic pesticides by a paper chromatographic method. The survey was conducted over a 4-month period starting in August. Twenty-three samples (2.5 percent) showed residues of 0.1 ppm or more. Of the 936 samples, 168 were further examined by the Food and Drug Administration's Division of Food. By paper chromatography, five of these, or 3.0 percent, showed significant residues.

These 168 samples were also analyzed in the Division of Food by a fly bioassay procedure. Depending upon the cleanup technique employed, toxic reactions were noted in 33 percent of the samples (florisil column) and in 54 percent of the samples (MgO column). Significant mortalities (taken as more than 10 percent of 100 flies) were 15.5 and 39.3 percent, respectively. The difference in incidence between the chromatographic and bioassay methods is due to the fact that the bioassay reflects the sum of all residues toxic to the housefly. Also, flies are extremely sensitive to certain pesticides (lindane, heptachlor or its epoxide, dieldrin, and others) and a few hundredths of a ppm of these might not register on the paper chromatogram. Comparable figures for the previous and the present survey are: 67 percent positive reactions in 1955 and 33 percent in 1958.

Investigations to determine the source of pesticide residues were limited to eight producers

whose milk was found to contain "substantial" residues. Of these, the source of contamination was definitely accounted for in only three cases. Feeding of DDT-contaminated corn silage (1.2 to 12 ppm DDT) was responsible for high residues, 4.8 and 6.33 ppm DDT, in one producer's milk. The contamination of the milk of the other two producers was traced to the careless spraying of barns with a concentrated DDT solution by a commercial exterminator.

The survey did not reveal any seasonal monthly differences in the occurrence of pesticide residues.

The survey showed that paper chromatography is a useful procedure in detecting substantial residues of organic chloride pesticides in fluid milk.

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Deaths From Septicemia

Septicemia and pyemia caused 1,633 deaths in 1958. Of these, 353 were staphylococcal, 64 streptococcal, and 30 pneumococcal. Other agents were specified for 90 of the deaths and 1,126 were unspecified. The increase in all deaths from septicemia and pyemia over the previous year was about 23 percent, and for staphylococcal septicemia it was about 63 percent. The number of deaths from sepsis among the newborn (infants under 1 month) was 1,055, an increase of about 27 percent over 1957. Deaths from septicemia during the period 1949 through 1957 were reported in *Public Health Reports*, April 1959, p. 354.

Kentucky Home Care



Sadieville, Ky.

Dear Doctor _____:

I want to express to you my sincerest appreciation for the work done by the health department in helping old people.

My mother Mrs. _____ aged 87 requested that her last days be spent at home rather than in a hospital. This request would have been impossible to grant had it not been for the untiring efforts of your health nurses.

Especially am I indebted to Mrs. _____. Mother anxiously awaited her visit each day. She always brought along a ray of sunshine with her. Towards the last, when mother was so ill, she worked fervently trying to ease her and make her more comfortable. She showed me many things that made the nursing job easier.

I think this home visitation by the nurses is the most wonderful thing that has happened for the physical welfare of the aged.

Again, may I congratulate you and your staff for the wonderful work which you are doing.

Best regards,
Mrs. _____

THIS LETTER and others like it put into words the public's warm, spontaneous response to Kentucky's home care program, which was set in motion January 1, 1958, by the State health department.

Cooperation the Keynote

Working closely with county medical societies and health agencies, the division of chronic diseases of the Kentucky State Department of Health spearheads and broadens the home care program throughout the State. This is done with the assistance of the department's divisions of health education, public health nursing, and nutrition.

The home care program is more than home nursing. It includes nutrition, physical therapy, and psychiatric and community services. Yet it remains essentially a simple type of service for chronically ill patients needing medical supervision but not hospitalization; those needing continuing medical care, instruction in self-administration of drugs, or special diets; and those who might benefit from home physiotherapy. Services also extend to patients in

nursing homes without a registered nurse on the staff.

In the five-county area selected for the program's demonstration, an additional nurse has been added to each county nursing staff. All the staff nurses have been trained further by the Louisville Visiting Nurse Association and the Rehabilitation Clinic of the Louisville General Hospital, and a nutritionist, physical therapist, and social worker have been made available by the State health department.

Physician and Nurse Liaison

Home care patients first enter the program on recommendation of the attending physician, who prescribes a specific regimen of care for the nurse. After the visit, the nurse reports back to the physician. The conditions found most frequently among home care patients are cancer, heart disease, hypertension, and rheumatic fever.

Public enthusiasm for the home care program

has brought the opportunity for group activities for the chronically ill and aged in one county, through a Senior Citizens Health Club.

To health agencies contemplating home care programs, the Kentucky State Department of Health offers these guidelines:

If you are waiting for more money, remember, there will never be enough. If there isn't adequate staff, let us use what we have. Leadership? Why not supply your own?

The people, the taxpayers know what they want. When they get services that they want they will support them. There is a lot of evidence that the people want tangible services—not just advice. Where tangible services are provided, the public supports the health department. It's just common sense.

To obtain more information about the Kentucky program of rural home care, write to Russell E. Teague, M.D., Secretary, Kentucky State Department of Health, Louisville, Ky., for a copy of the Bulletin of March-April 1959.

Cutler on Special Assignment

Dr. John C. Cutler, Assistant Surgeon General for Program, Public Health Service, has been assigned to the Allegheny County (Pa.) Health Department to direct that agency's central district.

The assignment was requested by the health directors of both the State and county, primarily to help materialize their plans for a local health demonstration unit which may serve as a model for other areas. Dr. Cutler has also joined the faculty of the University of Pittsburgh Graduate School of Public Health.

Prior to his current post, which he has held since July 1958, Dr. Cutler was assistant director of the National Institute of Allergy and Infectious Diseases, Public Health Service. After his appointment to the Commissioned Corps in 1942, he held a number of research,

instructional, and administrative posts in this country and abroad. He conducted venereal disease research at the Service's research laboratory at Staten Island before continuing his research and control work in this field overseas. In 1948 he received from the Guatemalan Government the Order of Merit for his work during an assignment to the Pan American Health Organization. He also organized a public health demonstration and training program in India for the World Health Organization in 1949-50.

Dr. Cutler is a diplomate of the American Board of Preventive Medicine and Public Health, a fellow of the American Public Health Association, counselor for the International Union Against Venereal Disease and Treponematoses, and director of the District of Columbia Social Hygiene Society.

A careful review of one county's hospital records contributes to the limited knowledge of the pattern of fetal and early neonatal loss and provides information about the adequacy of registration and the medical use of terminology.

Fetal and Early Neonatal Deaths in Onondaga County, New York

EDWARD R. SCHLESINGER, M.D., M.P.H., RUTH K. BEECROFT, M.D., M.P.H.,
HILDA F. SILVERMAN, B.S., and NORMAN C. ALLAWAY, M.Sc.

IN COMPARISON with infant and later mortality, relatively little is known about the incidence of fetal mortality, especially deaths occurring during the early months of gestation. Most information on fetal mortality relates to deaths occurring after 20 weeks of gestation. There are many reports on fetal mortality in individual hospitals, but these have the major drawback of possible selection of patients unrepresentative of the population as a whole. In a few areas, such as in New York City, reporting of fetal deaths at any stage of gestation is required. Since the responsibility for reporting fetal deaths in such an area rests mainly with the hospitals, the extent of possible under-reporting is difficult to ascertain.

Dr. Schlesinger is associate director of medical services, New York State Department of Health, Albany. Dr. Beecroft is regional medical director for the Children's Bureau, Department of Health, Education, and Welfare, Region II, New York City. The late Mrs. Silverman, biostatistician with the New York State Department of Health, supervised the field aspects of the study. Mr. Allaway is associate biostatistician with the department.

As one attempt to make up for these deficiencies, information has been obtained on fetal mortality covering an entire geographic area—Onondaga County, N.Y.—from a direct study of original hospital records. Although this method includes only fetal deaths requiring hospitalization of the mother, it does obviate the factor of selection of patients present in studies in individual hospitals. Furthermore, it permits comparison with data for New York City, where all but a negligible number of the fetal death reports emanate from hospitals.

The primary objective of the study was to obtain as complete a picture as possible, from a review of hospital records, of the incidence of fetal losses occurring in 1951 and 1952 among residents of Onondaga County who were hospitalized in the county. Neonatal deaths occurring during the first 24 hours after birth in the same years were included also because of the possible difficulty in distinguishing fetal deaths occurring immediately before or during birth from neonatal deaths occurring immediately after birth. A secondary objective was the exploration of such questions as the accuracy of the period of gestation reported on the still-birth certificate and the completeness of re-

porting of stillbirths (or fetal deaths occurring after a gestation period of 20 or more weeks, as defined for purposes of reporting in New York State) as compared with information from the hospital records.

Method

Onondaga County was selected for the study for several reasons. Its population, 342,000 at the time of the 1950 census, provided a large enough base for the development of significant rates. More than half the county's population was concentrated in Syracuse, the county seat and only city, which also was its trade center and center for medical and hospital care. Furthermore, all the hospitals in the county were located in Syracuse, and all but about 0.5 percent of the recorded births in the county occurred in these hospitals. Only 5 percent of the births to Onondaga County residents were recorded outside the county.

Local facilities and the possibilities of local cooperation were even more important determinants in the selection of Onondaga County. The performance of many studies in problems relating to fetal and neonatal mortality by the Syracuse City Department of Health and by the departments of obstetrics and pediatrics at the Upstate Medical Center of the University of the State of New York, in Syracuse, tended to assure a receptive attitude on the part of the hospital authorities. The location of a medical school in Syracuse made it feasible to obtain students for a review of hospital records during the summer months between their third and fourth years of medical school.

Four medical students were assigned to the study with the aim of locating as many as possible of the hospital records of fetal and early neonatal deaths in 1951 and 1952. Cases were included in the study if the delivery occurred in a hospital or if the mother was hospitalized within 2 weeks after the event. Each medical student was assigned to one or more hospitals, where he reviewed the records and tabulated the information on schedules designed for the purpose.

A search was first conducted of the diagnostic files of the hospital, using a special guide based on the Standard Nomenclature of Dis-

eases and Operations (1). The hospital discharge diagnosis file was the principal source of cases. This file was supplemented by referral to the doctor's diagnosis card and any other available official hospital files of neonatal deaths, fetal deaths, and operations. Other supplemental sources, when available, included the pathology laboratory file of diagnoses on surgical specimens and autopsies, including those obtained from dilatation and curettage; obstetrics and gynecologic service admitting books; any special files compiled for use of obstetrics and gynecology staff; and information from specific studies.

Review of a patient's chart included examination of the physicians' and nurses' notes, especially at the time of admission and in the delivery or operating room. Each chart was searched also for pathology laboratory reports, special attention being given to reports of microscopic specimens for findings of decidual tissue or other evidence of pregnancy. No cases were included in the study purely on the basis of a history of a pregnancy which terminated previous to 2 weeks before hospital admission. The length of gestation in weeks was calculated directly from information obtained from hospital records.

The decision as to whether any case should be recorded as a fetal death or an early neonatal death depended on information pertaining to evidence of life on the hospital records. Each fetal death was recorded, in accordance with the recommendation of the World Health Organization, as early (less than 20 completed weeks of gestation), intermediate (20 completed weeks

Table 1. Fetal and early neonatal mortality, Onondaga County, N.Y., 1951-52

Mortality index	1951	1952	1951-52
Fetal death ratio ¹ -----	87.1	90.5	88.9
Fetal death rate ² -----	80.2	83.0	81.6
Early neonatal death rate ³ -----	11.2	12.3	11.8
Fetal and early neonatal death rate ⁴ -----	90.5	94.3	92.4

¹ Fetal deaths per 1,000 live births.

² Fetal deaths per 1,000 live births and fetal deaths.

³ Early neonatal deaths (within 24 hours after birth) per 1,000 live births.

⁴ Fetal deaths and early neonatal deaths per 1,000 live births and fetal deaths.

Table 2. Distribution of fetal and early neonatal deaths according to the World Health Organization classification, Onondaga County, N.Y., 1951-52

Classification of deaths	Number	Percent
Total deaths-----	1, 707	100. 0
Fetal deaths-----	1, 456	85. 3
Early-----	985	¹ 67. 7
Intermediate-----	123	¹ 8. 4
Late-----	216	¹ 14. 8
Not stated-----	132	¹ 9. 1
Early neonatal deaths ² -----	193	11. 3
Period of death not stated-----	58	3. 4

¹ Percent of fetal deaths.

² Within 24 hours after birth.

of gestation but less than 28), late (28 completed weeks of gestation and over), or period of death not stated for a death that could not reasonably be classified. The physician's statement of the outcome (abortion, miscarriage, stillbirth, neonatal death, or not stated) was also recorded. Stillbirth and live birth certificates were reviewed, and the reported length of gestation was noted.

For residents of Syracuse the census tract in which the family resided was established, and mortality rates were related to the socioeconomic status of the tracts. Socioeconomic status was determined by using an index developed by Willie (2). This index is based on average monthly rental, market value of owned homes, proportion of detached single-family dwellings, median school years completed by adults 25 years of age or older, and the proportion of operatives, service workers, and laborers reported in the 1950 U.S. census. Six groups of census tracts were constituted, and were designated on a scale from I (high) to VI (low).

Results

The fetal and early neonatal death rates for each of the study years are given in table 1. For comparison with other areas, in which the ratio of fetal deaths to live births is used, rather than the ratio of fetal deaths to the total of live births and fetal deaths, the fetal death ratios are also given.

The number of fetal and neonatal deaths and the proportion of fetal deaths according to length of gestation, by the World Health Organization classification, are given in table 2. Sixty-eight percent of the 1,456 fetal deaths were classified as early, contrasted with 8.4 percent in the intermediate group and 14.8 percent in the late group; 9.1 percent could not be readily classified because of lack of information in the hospital records.

The only study which we have found to lend itself readily to comparison with the Onondaga County experience is one reported by Erhardt relating to New York City data for 1950 (3). As indicated previously, the New York City figures are based on reports submitted to the city department of health, rather than from a direct study of the hospital records. The type of material provided by the two studies is comparable, however, since the reports received in New York City emanate almost entirely from hospitals.

The proportions of classifiable fetal deaths in the early, intermediate, and late groups were very similar in the Onondaga County and New York City studies (table 3). The only marked

Table 3. Comparison of fetal deaths according to length of gestation, New York City, 1950, and Onondaga County, N.Y., 1951-52

Weeks of gestation	Number of fetal deaths		Percentage distribution ¹	
	Onondaga County	New York City	Onondaga County	New York City
0-19 (early)-----	985	12, 255	74. 4	77. 0
0-3-----	23	85	1. 7	. 5
4-7-----	89	2, 179	6. 7	13. 7
8-11-----	408	5, 620	30. 8	35. 3
12-15-----	333	2, 937	25. 2	18. 4
16-19-----	132	1, 434	10. 0	9. 0
20-27 (intermediate)-----	123	1, 337	9. 3	8. 4
20-23-----	76	894	5. 7	5. 6
24-27-----	47	443	3. 5	2. 8
28 or more (late)-----	216	2, 328	16. 3	14. 6
28-31-----	43	417	3. 2	2. 6
32-35-----	41	404	3. 1	2. 5
36-39-----	76	468	5. 7	2. 9
40 or more-----	56	1, 039	4. 2	6. 5
Unknown-----	132	485	-----	-----
Total-----	1, 456	16, 405	-----	-----

¹ Based on fetal death records from which length of gestation could be calculated.

Table 4. Fetal and early neonatal death rates by age of mother, Onondaga County, N.Y., 1951-52

Age of mother (years)	Fetal death rate ¹	Early neonatal death rate ²
Less than 20	55.4	11.7
20-24	67.0	9.9
25-29	69.8	9.8
30-34	90.7	11.3
35-39	130.7	20.6
40 or over	184.8	23.3

¹ Fetal deaths per 1,000 live births and fetal deaths.

² Deaths within 24 hours after birth per 1,000 live births.

differences in distribution of fetal deaths occurred in the breakdown of early fetal deaths by 4-week periods. The proportion of fetal deaths in the 4- to 7-week and the 8- to 11-week groups is higher in New York City. These differences were balanced by a higher proportion of deaths between 12 and 20 weeks of gestation in Onondaga County. Whether these differences are real or due simply to errors in reporting cannot be determined. If the latter, it would mean that there is a tendency for hospitals to report fetal deaths occurring before the 20th week of gestation as having a shorter gestation period than is actually the case, since the Onondaga County data are based on direct calculation of the length of gestation from data in the hospital records.

Table 5. Fetal and early neonatal death rates by socioeconomic status of census tract of family residence, Syracuse, N.Y., 1951-52

Socioeconomic status ¹	Number of census tracts	Fetal death rate ²	Early neonatal death rate ³
I	3	88.7	3.7
II	6	99.9	9.8
III	10	79.7	10.0
IV	11	92.6	10.0
V	12	93.6	13.6
VI	17	97.3	16.1

¹ I is highest, VI is lowest.

² Fetal deaths per 1,000 live births and fetal deaths.

³ Deaths within 24 hours after birth per 1,000 live births.

As shown by the data in table 4, the fetal death rate increased steadily with advancing age of the mother, with a sharp increase after age 35 years. The early neonatal death rate was definitely higher only in the groups aged 35 years and over. Since the number of early neonatal deaths is much smaller than that of fetal deaths, however, the variations in the early neonatal death rates are not as significant.

A crude index of the relationship of socioeconomic status and fetal and early neonatal mortality among Syracuse residents is presented in table 5. The census tracts are grouped by descending status from the highest in group I to the lowest in group VI. It should be emphasized that the considerable degree of variation in socioeconomic status within the census tracts may tend to reduce the sharpness of any differences among the various tracts. No trend in the fetal death rates is discernible with change in socioeconomic status. On the other hand, the early neonatal death rate, even though based on smaller numbers, shows a distinct increase with decline in socioeconomic status.

Table 6 shows the extent of agreement, within 2 weeks, of the length of gestation as calculated from 382 hospital records with that stated on

Table 6. Extent of agreement, within 2 weeks, of length of gestation reported on hospital records and on stillbirth and birth certificates, Onondaga County, N.Y., 1951-52

Weeks of gestation reported on hospital record	Fetal deaths		Early neonatal deaths ¹	
	Number	Percent agreement with vital record	Number	Percent agreement with vital record
Total deaths registered	228	64.9	154	65.6
Less than 20 ²	1		5	60.0
20-23	16	75.0	24	62.5
24-27	28	53.6	41	56.1
28-31	31	48.4	16	68.8
32-35	33	69.7	10	60.0
36-41	102	73.5	46	80.4
42 or more	17	41.2	12	50.0

¹ Within 24 hours after birth.

² Stillbirth certificate not required.

Table 7. Extent and kind of vital registration compared with the World Health Organization classification of deaths, Onondaga County, N.Y., 1951-52

Classification of deaths	Total	Vital record filed		
		None	Still-birth certificate	Birth and death certificates
Total deaths.....	1, 707	1, 230	284	193
Early fetal death ¹	985	983	1	1
Intermediate fetal death.....	123	71	52	0
Late fetal death.....	216	14	202	0
Fetal death, group not classifiable.....	132	117	15	0
Early neonatal death ²	193	4	2	187
Death not classifiable.....	58	41	12	5

¹ Stillbirth certificate not required.

² Within 24 hours after birth.

stillbirth and live birth certificates. (Only fetal deaths after 20 or more weeks of gestation are reportable in New York State outside New York City.) Among both the fetal deaths and the early neonatal deaths there is about two-thirds agreement. There appears to be greater agreement at and around term than at other periods of gestation.

An analysis of the extent and kind of vital registration according to the World Health Organization classification of deaths is presented in table 7. The greatest degree of under-registration among the deaths for which reporting is mandated was found among the intermediate fetal deaths. In this group, stillbirth certificates were filed for only 52 out of 123, or 42 percent of the deaths. Among the 216 late fetal deaths, 94 percent were registered as stillbirths. Of the 194 early neonatal deaths, 97 percent were registered as births and deaths, 1 percent were registered as stillbirths, and 2 percent were not registered.

Comparison of evidence of life found in hospital records with the kind of vital record filed revealed a close correspondence between the two (table 8). Of the deaths with evidence of life indicated in the hospital record, all but six had birth and death certificates filed. Among

these six, there were two registered as stillbirths. One of these, at 22 weeks' gestation, was stated to have had a detectable heartbeat for several minutes. The other, surprisingly, had a calculated length of gestation of 40 weeks and was stated to have lived for 7 hours.

There were four deaths with recorded evidence of life which were not registered. Every one of these had periods of gestation of less than 20 weeks, and in each instance the evidence of life after delivery was fleeting. The large number of instances in which there was no specific reference on the hospital record to presence or absence of life is rather striking.

The relationship between the physician's statement of the outcome of pregnancy in clinical terms to the outcome according to the World Health Organization classification was the final point investigated. Roughly, the term "abortus" or "abortion" corresponds to early fetal death, "miscarriage" to intermediate fetal death, and "stillbirth" to late fetal death. Comparison revealed the greatest degree of agreement, 92 percent, between the physician's statement of abortion and early fetal deaths among those classifiable by the World Health Organization's definitions (table 9). Agreement between the use of the term "stillbirth" and the classification as late fetal death, 82 percent, was less, but only in the use of the term "miscarriage" was there a gross discrepancy. Only 5 out of 23 deaths called miscarriages with calculable periods of gestation, or 22 percent, fell within the limits for intermediate fetal deaths. Fourteen, or 61 percent, corresponded to early fetal deaths, and 4, or 17 percent, to late

Table 8. Relation between evidence of life and extent and kind of vital registration, Onondaga County, N.Y., 1951-52

Vital record filed	Total	Evidence of life		
		No	Yes	Not stated
Total deaths.....	1, 707	1, 147	185	375
None.....	1, 230	919	4	307
Stillbirth certificate.....	284	227	2	55
Birth and death certificates.....	193	1	179	13

Table 9. Physician's statement of outcome compared with World Health Organization classification of deaths, Onondaga County, N.Y., 1951-52

Classification of deaths	Total	Physician's statement					
		Abortion	Miscarriage	Stillbirth	Neonatal death	Other	Not stated
Total deaths.....	1,707	1,142	43	265	187	49	21
Early fetal death.....	985	925	14	1	0	41	4
Intermediate fetal death.....	123	74	5	43	0	1	0
Late fetal death.....	216	10	4	201	0	0	1
Fetal death, group not classifiable.....	132	94	15	15	0	6	2
Early neonatal death ¹	194	4	0	2	187	0	0
Death not classifiable.....	58	35	5	3	0	1	14

¹ Within 24 hours after birth.

fetal deaths. A larger proportion of deaths termed miscarriages were not classifiable by World Health Organization definition than either abortions or stillbirths.

Summary

A study was made of 1951 and 1952 hospital records in Onondaga County, N.Y., to determine the incidence of fetal and early neonatal losses.

Of the total of 1,456 fetal deaths, 67.7 percent occurred before 20 weeks of gestation, 8.4 percent between 20 weeks and 28 weeks, and 14.8 percent after 28 weeks; 9.1 percent could not be readily classified. The proportions of classifiable fetal deaths in the early, intermediate, and late groups were very similar to those found in New York City studies based on reports to the city health department.

The fetal death rates and, to a lesser extent, the early neonatal death rates increased with advancing age of the mother. No trend was discernible in the fetal deaths with change in socioeconomic status of the census tract of family residence, but the early neonatal death rate was inversely related to socioeconomic status.

Agreement between the length of gestation calculated from the hospital records and that stated on the registration forms was about two-thirds for both fetal and early neonatal deaths. Under-registration was greatest for the intermediate fetal deaths, with only 42 percent of such deaths registered. Only 6 out of 182 deaths with evidence of life indicated in the hospital records, however, did not have live birth and death certificates filed. In comparing the physician's statement of the outcome of pregnancy with the classification of the deaths according to the World Health Organization definitions, agreement was lowest between the term "miscarriage" and the corresponding classification of intermediate fetal death.

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- (3) Erhardt, C. L.: Reporting of fetal deaths in New York City. Pub. Health Rep. 67: 1161-1167, December 1952.

Sampling Microbiological Aerosols

ANALYSIS of biological forms in the atmosphere has not, until recently, enjoyed the attention given to the study of chemical, inert, and radioactive pollutants. However, the emergence of antibiotic resistant staphylococcal strains in hospitals, the high prevalence of minor respiratory illness revealed by the U.S. National Health Survey, and the potentialities of biological warfare have stimulated attention to the processes of airborne infection and the use of instruments to detect, identify, and assess biological contamination of the air. In particular, instrument methods are sought to sample the flora of the atmosphere.

This monograph acquaints personnel in hospitals and government and private research laboratories and other interested persons with the principles and problems of sampling airborne micro-organisms and with the numerous devices that can be used for a variety of air-sampling conditions. It serves as an aid to those establishing and conducting a biological air-sampling program by supplying information concerning bacterial air-sampling methods, particle sizing, selection of samplers, operational methods, and descriptions and characteristics of many different biological air samplers.

The basic methods of aerosol sampling are: impingement in liquids, impaction on solid surfaces, filtration, sedimentation, centrifugation, electrostatic precipitation, and thermal precipitation. Samplers based on all of these methods have been developed and are described in the monograph.

When selecting a sampler for a specific sampling program one must first have a clear understanding of the type of information that is desired and the particular determinations that must be made. For example, in the studies of airborne micro-organisms and their relation to respiratory infections, information is required concerning the size of the sampled particles. This can be obtained by use of impac-

tion-type samplers, which contain a series of stages through which air passes at different velocities.

For other studies it may be desirable to determine how the airborne microbiological content varies with time. This also can be accomplished with impaction-type samplers if the impacting surface is moved in such a way that the location of the aerosol particles on the collecting surfaces indicates the time that the particles were collected.

No one type of sampler can provide the answers required for all sampling problems. It is because of this consideration that so many different types of aerosol samplers have been de-

Public Health Monograph No. 60

Sampling Microbiological Aerosols. By Harold W. Wolf, Peter Skaliy, Lawrence B. Hall, Marvin M. Harris, Herbert M. Decker, Lee M. Buchanan, and Charles M. Dahlgren. Public Health Monograph No. 60 (PHS Pub. No. 686), 53 pages, illustrated. U.S. Government Printing Office, Washington, D.C., 1959, 45 cents.

The accompanying summary covers the principal contents of Public Health Monograph No. 60, published concurrently with this issue of *Public Health Reports*. This monograph is the joint work of members of the Technical Development Laboratories, Communicable Disease Center, Public Health Service, and the U.S. Army Chemical Corps, Fort Detrick, Md.

For readers wishing the data in full, copies are on sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. Official agencies and others directly concerned may obtain single sample copies without charge from the Public Inquiries Branch, Office of Information, Public Health Service. Copies will be found also in the libraries of professional schools and the major universities and in selected public libraries.

veloped. To help the investigator select the type most adaptable to his particular problem, a table lists the samplers according to the basic methods of aerosol sampling and gives operating characteristics and limitations of each type.

A section devoted to operational methods discusses the control and measurement of air-sampling rates, sterilization of samplers, formulations of bacteriological media and collecting fluids, and processing of samples. It contains formulas for computation of sampling data.

Another section contains suggestions for consideration when planning a sampling program. Since selection of a proper sampler is also de-

pendent upon the expected concentration that must be sampled, information is provided on the normal bacterial levels found in an industrialized urban area and in a rural area. Bacterial levels created by various activities inside several buildings are also presented.

The final chapter illustrates 37 different biological samplers. Accompanying each illustration is a detailed description of the sampler, including operating information. References relating to the use of the sampler and the commercial source are listed. If the sampler is not commercially available, a source is given where engineering drawings can be obtained.

International Conference on Mental Retardation

A pioneer worldwide medical conference for the purpose of bringing into sharper focus and evaluating causes of mental retardation was held in Portland, Maine, July 27-31, 1959. More than 600 conferees representing 40 States in this country and 33 foreign lands attended the sessions.

Underscoring the need for continuing research in mental deficiency, the First International Medical Conference on Mental Retardation set up a permanent organization for concerted work. A permanent committee was organized of physicians from Wales, Germany, Austria, Sweden, Denmark, Italy, Poland, France, Argentina, and the United States. Dr. K. Kundratitz of Vienna, Austria, was named chairman. That city was selected for the 1961 conference.

Featuring 35 speakers, the program included reports on pathological findings in the brain of mentally retarded patients; malformations produced in animals by abnormal food, poisons, or other types of damage; inborn metabolic errors explained by abnormalities in the enzyme function; experiments

in autonomic regulation in the brain; pathological findings in birth trauma and asphyxia; differences of metabolism and oxygen utilization in animals before and after birth; sequels of infectious diseases of the central nervous system in respect to mental development; metabolism of the amino acids and the diseases now considered related to abnormalities in amino acid metabolism; the metabolism of copper, iron, and lead and related diseases with mental deterioration; and recent findings of chromosomal abnormalities in mentally retarded persons.

Conference exhibits included aspects of phenylketonuria; a simple method for the detection of amino-aciduria; rare types of mental deficiency; toxoplasmosis; and ataractics in the treatment of mentally retarded children.

The conference recommended that all governments of the world set aside sufficient funds for furthering knowledge of mental retardation, as well as its medical treatment and social and educational needs.

Proceedings of the conference will be available in published form in the spring of 1960.

Federal Publications

Proceedings of the 1959 Annual Conference of the Surgeon General, Public Health Service, With State and Territorial Mental Health Authorities. *PHS Publication No. 705; 1959; 36 pages.*

Addresses and actions of the annual conference of the Surgeon General with mental health authorities are reported. This is his first conference with this group at a time different from the meeting with State and Territorial health officers.

Recommendations pertain to the use of Hill-Burton funds for joint interstate facilities, an ad hoc committee to work with the Service in formulating treatment and administrative guidelines for statewide plans for mental health facilities, study of patient-care costs, training and research programs, matching requirements for community mental health grants, additional grant aid where needed, amendment of social security laws relating to mental health patients, projects in research applications, aftercare programs and services, and vocational rehabilitation.

Health Statistics From the U.S. National Health Survey. Limitation of activity and mobility due to chronic conditions, United States, July 1957-June 1958. *PHS Publication No. 584-B11; 1959; 40 pages; 30 cents.*

Activity limitation data in this report refer to persons reported in household interviews as being unable to carry on their major activities of working, keeping house, or going to school; limited in amount or kind of major activity; or not curtailed in major activity but otherwise restricted. Mobility limitation data describe persons having difficulty getting around alone, unable to get around alone, or confined to the house. Twenty tables show numbers and percentage distributions by major activity, family income, sex and age, sex and urban-rural resi-

dence, and age and urban-rural residence.

The appendixes carry technical notes on methods, definitions of terms, and a reproduction of the questionnaire on which the information was elicited.

Sanitary Engineering Manpower. *PHS Publication No. 703; 1959; by Frank A. Butrico and Israel Light; 32 pages; 25 cents.*

An attempt to assess the strength of the sanitary engineering specialty, this booklet presents a composite picture of almost two-thirds of the total estimated sanitary engineers in the country. It gives the age, education, professional experience, years of service, kind of work and type of employer, income, and related characteristics of approximately 4,000 such engineers.

The original data were gathered in cooperation with the National Science Foundation's Scientific and Engineering Manpower Unit.

Bibliography on Cancer for Nurses. *PHS Publication No. 687 (Public Health Bibliography Series No. 26); 1959; by Patricia B. Geiser; 38 pages; 20 cents.*

Four hundred and fifty-one selected references and thirty-seven films are listed to help nurses and nursing students locate source material from nursing and other related fields. References from professional journals and the films are annotated.

A list of companies that manufacture prosthetic devices and equipment used in the care of patients with cancer is also provided.

Methods of Making Sanitation Ratings of Milk Sheds. *PHS Publication No. 678; 1959; 19 pages; 15 cents.*

Procedures for evaluating community milk supplies are presented to help State milk control authorities measure objectively the extent to which communities adopting the

Milk Ordinance and Code recommended by the Public Health Service are enforcing its provisions. Figures are included to show how data collected are tabulated and the numerical rating calculated.

This booklet can also be used as a guide for rating interstate milk supplies under the cooperative State-*PHS* voluntary program.

Examinations for Cervical Cancer. *PHS Publication No. 707; 1959; leaflet.* Intended for private practitioners and physicians attending beneficiaries of governmental medical care. Briefly describes digital and visual examinations, Papanicolaou smear, and Schiller test and biopsy. Outlines steps in prevention and control of cervical cancer. Depicts advantages of early diagnosis.

Facts on Blindness in the United States. *PHS Publication No. 706; 1959; 6 pages; single copies 5 cents, \$2.50 per 100.*

Written for the general public, this leaflet is intended for use by health departments and community groups in promoting information programs and glaucoma casefinding activities.

It identifies the 10 leading causes of blindness and emphasizes the importance of periodic physical examinations in preventing unnecessary loss of sight. Text and tables present basic information on incidence and prevalence of blindness and the cost of financial aid to the blind.

This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared with Federal support.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Office of Information, Public Health Service, Washington 25, D.C.

The Public Health Service does not supply publications other than its own.

ECMOES

EXPERIMENTAL STUDIES OF NATURAL PURIFICATION IN POLLUTED WATERS

IV. THE INFLUENCE OF THE PLANKTON ON THE BIOCHEMICAL OXIDATION OF ORGANIC MATTER

By C. T. BUTTERFIELD, *Bacteriologist*, W. C. PURDY, *Plankton Expert*, and E. J. THERIAULT, *Chemist*, *United States Public Health Service*

The abstraction of dissolved oxygen from polluted water during the natural purification process is a well-known phenomenon. It is also well known that the amount of dissolved oxygen used up is definitely related to the amount of pollution present. While these facts in regard to the natural purification of polluted water are well established, the mechanism by which the oxidation is accomplished can only be surmised. For instance, if a portion of polluted water is examined, many bacteria and plankton are found. If all of these organisms are killed or removed from the water, oxidation ceases. The interreactions of these biological factors and the part that each plays in the process of natural purification constitute the subject of this study.

Extensive studies are described in the literature on the rate and extent of biochemical oxidation of polluted water. In general, these studies have been confined to a determination of the amounts of dissolved oxygen absorbed after various periods of incubation at different temperatures without reference to the biological factors con-

FEBRUARY 20, 1931, pp. 393-426

C. T. Butterfield, W. C. Purdy, and E. J. Theriault advanced the theory that the chief function of certain plankton in the biochemical oxidation process was to reduce bacteria below the saturation point, thus providing conditions suitable for bacterial multiplication, which resulted in more complete oxidation. In a series of seven articles they reported experimental studies of the interaction of biological factors in the natural purification of polluted waters.

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and

Public Health Monographs

Numbers 56–60

THIS INDEX to *Public Health Reports* and Public Health Monographs is divided into a subject index and an author index.

The subject index carries one or more entries for each item published. In addition to the subject headings, categorical headings include ANNOUNCEMENTS (EXAMINATIONS, ORGANIZATIONS, PERSONNEL), CONFERENCE REPORTS, DEATHS, LEGAL NOTES, and MONOGRAPHS.

Public Health Monographs published concurrently with *Public Health Reports* in 1959 are listed in numerical order under the category heading MONOGRAPHS. The monograph summaries appearing in the journal are indexed under appropriate subject headings.

One asterisk before the page number indicates an original, signed article. The sign of two asterisks, used only in the author index, indicates a monograph. Entries without any symbol may refer to summaries or briefs of papers presented at conferences, narrative conference reports, statements or reports of committees, short reports without authors, or similar items.

Illustrative material on the inside of the front cover of each issue is indexed by month under the heading FRONTISPIECES. It is recommended that the covers be included in a bound volume.

An annual list of Public Health Service publications may be obtained from the Public Inquiries Branch, Office of Information.

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EDITOR'S CORRECTION

In the article entitled "Inapparent Infection: Relation of Latent and Dormant Infections to Microbial Persistence," by Walsh McDermott, M.D., *Public Health Reports*, June 1959, the seven paragraphs beginning with "It might well be questioned . . ." on page 493, middle of the first column, and ending with ". . . with dysentery bacilli" on page 494, bottom of first column, should be inserted on page 489, second column, preceding the subhead "The Antimicrobial Drug."

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